

# MacBook Pro (13-inch, M1, 2020) Overview

## MacBook Pro (13-inch, M1, 2020) Overview



### Features

- **Processor:**
  - 8-core CPU
  - 8-core GPU
  - 16-core Neural Engine
- **Storage:** 256GB, configurable to 2TB
- **Memory:** 8GB of 4266MHz LPDDR4e onboard, configurable to 16GB

Apple.com provides full [product configuration](#) details and [Tech Specs](#).

### What's New

- Apple Silicon Technology Overview
- Quick Start Guide
- Frequently Asked Questions (FAQ)
- Service Considerations for Mac Computers with Apple Silicon
- How to Identify Mac Computers with Apple Silicon
- Additional Resources

### Important Service Considerations

- **Important:** Only [Apple-certified technicians](#) should repair this computer.
- **Battery Safety:** Before beginning any repair procedure, install the battery cover, disconnect the Battery Management Unit (BMU) flex cable and remove the BMU screw.

- **Battery Service:** The battery is not a replaceable part. Never remove the battery from the top case. To replace a battery, you must replace the top case.
- **Diagnostics:** After repair completion, verify the repair was successful by running the [required diagnostics based on the repair module that was replaced](#).
- **System Configuration:** [System Configuration](#) must be performed after a **display, logic board, Touch ID board, or top case** repair.
- **Logic Board and Touch ID Board:** If you replace the logic board, you must also replace the Touch ID board. However, you don't need to replace the logic board if only the Touch ID board is replaced.
- **Heat Sink:** The heat sink is not separately serviceable. If a heat sink needs to be replaced, you must replace the logic board.
- **Top Case:**
  - The top case comes with the battery, BMU, keyboard, microphone, and Touch Bar flex cables. If the battery, keyboard, or microphone must be replaced, you must replace the top case. Returned top cases must be packaged according to [strict guidelines](#).
  - Regional top cases have the same base part number, but they include a language code prefix (for example, Italian = T661-18432). Be sure to [choose the correct keyboard language](#) when ordering a top case. Replacement top cases must use the same language as the original top case.

## Starter Kits

The following kits are needed to service this computer:

- Battery Safety Kit, refer to [About embedded battery safety](#) (OP685)
- Battery Cover, 923-01318, package of two
- Bottom Case removal/install fixture kit, 076-00290
- Touch ID alignment kit, 923-03032

## Use Software Update

MacBook Pro (13-inch, M1, 2020) ships with a model-specific version of macOS. [Use the Mac operating system that came with your Mac, or a compatible newer version](#) (HT201686) to make sure the system build is correct for this computer model. Use Software Update to check for and apply the latest software and firmware updates.



# Reference Guide for Mac Computers with Apple Silicon

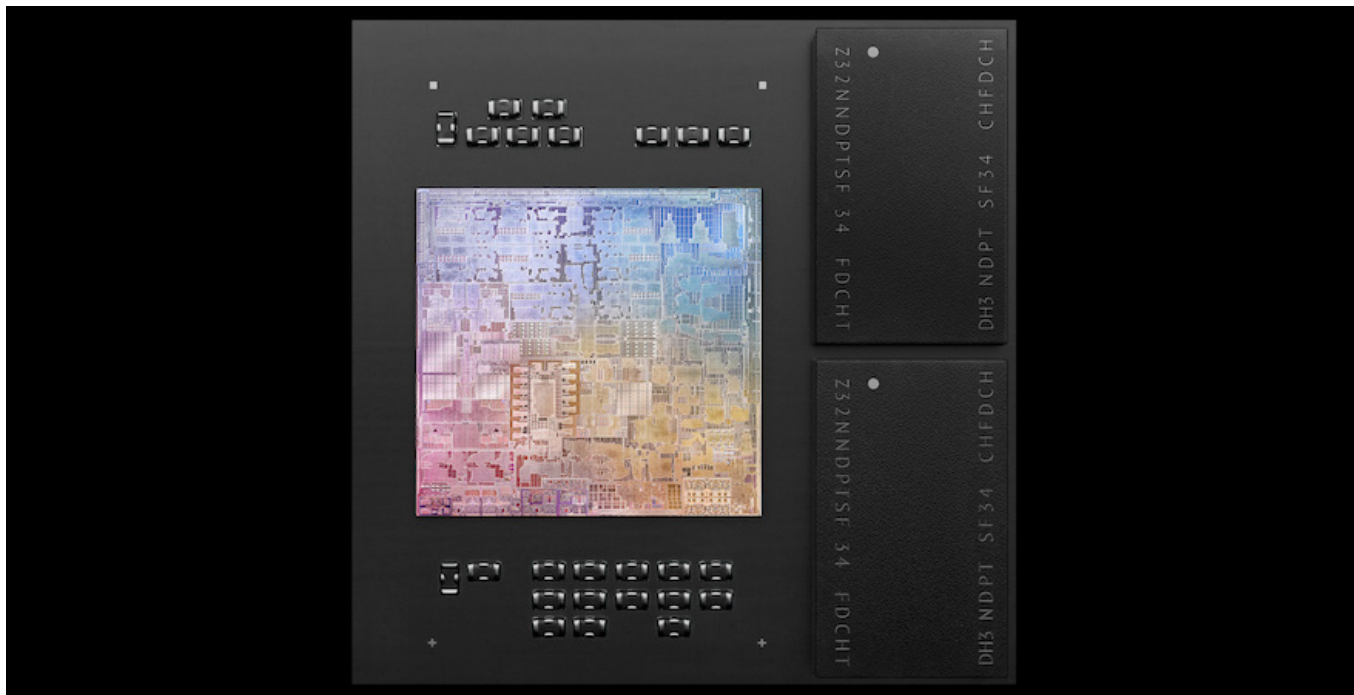
## Contents of this article:

- [Apple Silicon Technology Overview](#)
- [Quick Start](#)
- [Service Considerations](#)
- [Frequently Asked Questions \(FAQ\)](#)
- [How to identify a Mac with Apple Silicon](#)
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## Apple Silicon Technology

Apple introduces the first Apple silicon designed specifically for the Mac. As a system on a chip (SoC), M1 combines numerous powerful technologies into a single chip, and features a unified memory architecture for dramatically improved performance and efficiency. Many of the technical procedures required to troubleshoot and repair an Intel-based Mac are still relevant for a Mac with Apple silicon. However, some things have changed, such as no SMC or NVRAM resets, a new startup options screen, simplified System Configuration workflow, and more. You'll want to think different when it comes to troubleshooting and repairing a Mac with Apple silicon.

[Learn all about Apple silicon and M1 chip.](#)



## Quick Start

This chart will help you quickly identify similarities and differences between a Mac with Apple silicon and previous Intel-based Mac computers. In-depth details related to each topic are provided in the other sections of this article.

Topic	Apple Silicon	Intel	Summary
<b>Startup options</b>	Press and hold the power button for 10 seconds.	Press and hold the Option (Alt) key immediately after turning on or restarting your Mac.	Startup options is a new interface to access macOS Recovery, choose a startup disk, launch Diagnostics Mode, and more.
<b>macOS Recovery</b>	From startup options, select the Options gear, then Continue.	Press the power button, then immediately press and hold the Command ( ) and R key.	Familiar UI and utilities such as Disk Utility and Reinstall macOS. Disk Sharing is a new utility for Mac computers with Apple silicon.

Topic	Apple Silicon	Intel	Summary
<b>Launch Diagnostics</b>	From startup options, press and hold the Command ( ) and D key.	Press the power button, then immediately press and hold the Option and D key.	Simplified UI makes it easy to start up to Diagnostics Mode.
<b>Safe Mode</b>	From startup options, hold the Shift key while you click the startup disk you want to start up from.	Press the power button, then immediately press and hold the Shift key.	<a href="#">Safe Mode</a> (HT201262) may help you diagnose problems.
<b>Disk Sharing</b>	From macOS Recovery, choose Utilities > Share Disk.	Press the power button, then immediately press and hold the T key.	Connect a Mac with Apple silicon to another computer using a Thunderbolt or USB-C cable to access files.
<b>Diagnostic suites and tests</b>	OS only	EFI and OS	All diagnostic tests and suites are now OS based, can be interactive, and no local net boot server is required because the diagnostic resources are served from the cloud.
<b>Reset the SMC</b>	Not required.	Press and hold all of the following keys: Control on the left side of your keyboard, Option (Alt) on the left side of your keyboard, and Shift on the right side of your keyboard. Then press and hold the power button as well.	No need to reset the SMC on a Mac with Apple silicon.
<b>Reset NVRAM or PRAM</b>	Not required.	Shut down the Mac, then turn it on and immediately press and hold these four keys together: Option, Command, P, and R.	No need to reset NVRAM on a Mac with Apple silicon.
<b>System Configuration</b>	Simplified process. No Host computer or DFU mode required.	Host computer, MCU, and DFU mode.	<a href="#">System Configuration for Mac Computers with Apple Silicon</a> (TP1901) streamlines the repair completion workflow.  The workflow for <a href="#">System Configuration for Mac computers with the Apple T2 Security Chip</a> (TP1657) remains the same.
<b>Displays</b>	Supports one display up to 6K resolution at 60Hz.	Display support for multiple displays at various resolutions.	Refer to the <a href="#">tech specs</a> for full display support information.
<b>Apple Configurator 2</b>	New use cases to revive and restore. Required after logic board replacement.	Used to revive and restore Mac computers with the Apple T2 Security Chip.	New use cases for if a Mac computer with Apple silicon becomes unresponsive and the firmware and software must be revived or restored. Refer to the Service Considerations section below for additional information.

## Service Considerations

### Diagnostics

- To enter Diagnostics Mode on a Mac with Apple silicon, hold the power button for 10 seconds to start up to startup options, then press and hold Command ( ) + D.
- The Mac diagnostic categories in the AST 2 Diagnostic Console have been streamlined to match the categories found

in Diagnostics for iOS. The three diagnostic categories are Triage, Tools, and Post-Repair.

- Refer to [TP1909: Diagnostics for Mac Computers with Apple Silicon](#) for additional details, including:
  - diagnostic suites and tests available in each of the three categories
  - when you should run a diagnostic suite or test
  - which diagnostics you should run after a repair procedure
- The language selection for Diagnostics Mode on the user's computer is determined by the language setting in the user's macOS. If you need to change the language for Diagnostics Mode, start up to the user's macOS and select the desired language.
- Ensure the computer is shutdown after you have finished running diagnostic tests and suites. A Mac with Apple silicon will remain at the Waiting for Support screen in Diagnostics Mode even when the Diagnostic session in the AST 2 Diagnostic Console has been archived. This will cause the battery on a notebook to drain, even if the display is closed.
- If you encounter unexpected behavior when attempting to enter Diagnostics Mode or when running diagnostics, check for [known diagnostic issues](#) (OP1773) before escalating to Channel Service Support (CSS).

## System Configuration

- [System Configuration for Mac Computers with Apple Silicon](#) (TP1901) has been simplified from the process used for [Mac computers with the Apple T2 Security Chip](#) (TP1657).
- You don't need a host computer to run System Configuration on a Mac with Apple silicon. Also, you don't need to put the computer into DFU mode.
- After a logic board repair, the Mac will chime twice on startup until the System Configuration suite is run. This is expected behavior.
- A computer or internet device is still needed to initiate a diagnostic session using the [AST 2 Diagnostic Console](#).

## Apple Configurator 2

- Apple Configurator 2 has the following new use cases:
  - Revive or restore a Mac with Apple silicon that may have failed an update, installation, or reinstallation from macOS Recovery.
  - Complete a logic board repair after successfully running the System Configuration suite, by installing the latest versions of macOS and macOS Recovery.
- Find additional details on [when to use Apple Configurator 2](#) (TP1954).
- The ports used to place a Mac with Apple silicon in DFU mode are different than what's used for an Intel-based Mac. Pay close attention to which port you are using whenever DFU mode is required.

## Frequently Asked Questions (FAQ)

### Startup

#### **I hear the startup chime. Can I rely on this for troubleshooting?**

The return of the startup chime is exciting, however don't rely on it for troubleshooting as there is now an option to turn it on or off in System Preferences > Sound.

#### **The keyboard and mouse don't seem to be working when the computer is starting up. How can I fix this?**

Good news! Nothing to fix! Your favorite key combinations will still be used for Intel based Mac computers, such as SMC reset, PRAM reset, safe mode, etc., however they are no longer required for Mac computers with Apple silicon.

### Startup Options

#### **The startup options window on a Mac with Apple silicon looks like Startup Manager on an Intel-based Mac. Are they the same?**

While [startup options](#) (HT211873) and [Startup Manager](#) (HT202796) both allow you to select a different startup disk the similarities end there. Startup options allows you to start up to macOS Recovery, launch Diagnostics mode, and choose a startup disk to start up in Safe Mode. Think of startup options as the bridge to the different environments you'll use for troubleshooting.

### Reinstalling macOS

#### **How do I start up to macOS Recovery?**

Hold the power button for 10 seconds. Select the Options gear, then Continue to start up to [macOS Recovery](#) (HT204904).

#### **Can I still access Internet Recovery?**

If you can't start up to macOS or macOS Recovery, attempt to revive the computer. Refer to the [Apple Configurator 2 User Guide](#) and follow the revive instructions to update the firmware and macOS Recovery to the latest version.

### Repair

#### **Do I still need to run System Configuration to complete certain repair procedures?**

Yes. You still need to run the [System Configuration suite](#) (TP1901) after installing some replacement parts. However, the process has been simplified for a Mac with Apple silicon.

#### **Do I need to put a Mac with Apple silicon in DFU mode to run System Configuration?**

No. For repair procedures that require System Configuration, with the exception of a logic board, a Mac with Apple silicon will start up to macOS. When you replace a logic board, the computer will automatically start up to diagnostics mode.

### **Data Transfer**

#### **I want to show a user how to transfer data to another Mac, but it doesn't appear over Wi-Fi. What should I do?**

[Disk Sharing](#) (TP1908) requires a connection to another Mac with either a USB or Thunderbolt cable.

### **Diagnostics and Troubleshooting**

#### **I'm holding the Shift key during startup to enter Safe Mode, but nothing happens. Has Safe Mode changed?**

[Safe Mode](#) (HT201262) hasn't changed, but the method to start up in Safe Mode has. To start up the computer in Safe Mode, hold the power button for 10 seconds to enter startup options. Then, hold Shift while selecting the desired startup volume.

**Note:** Safe Mode is helpful when validating a possible software issue.

#### **I'm holding the Command ( ) and D keys during startup, but can't get into Diagnostics Mode.**

Start up the Mac to startup options, then press and hold the Command ( ) and D keys to enter Diagnostics Mode.

**Note:** You'll still use the Apple Service Toolkit 2 (AST 2) Diagnostic Console to initiate and run diagnostics tests and suites on the user's computer.

### **SMC and NVRAM resets**

#### **Why can't I reset the SMC on a Mac with Apple silicon?**

While it's still technically possible, the likelihood that you'll need to reset the SMC is incredibly low. The Apple silicon system on a chip (SOC) handles all of the communication previously managed by the System Management Controller (SMC). Because of this, and similar to iOS devices, a shutdown will resolve most issues related power, battery, fans, and other features.

#### **What about NVRAM? Isn't it possible for that information to become corrupt?**

Similar to the SMC reset, it's unlikely that you'll need to reset NVRAM on a Mac with Apple silicon because the settings that are stored in NVRAM, such as sound volume, display resolution, startup disk selection, etc., are now stored in the System region of the storage volume.

## **How to Identify a Mac with Apple Silicon**

- Choose About this Mac from the Menu. The description of a Mac with Apple silicon includes the Apple chip name, for example: Apple M1.
- Mac notebooks with Apple silicon have a globe icon on the Fn (Function) key.
- Mac mini (M1, 2020) has two Thunderbolt / USB 4 ports.

# Diagnostics for Mac Computers with Apple Silicon

This article provides details for running diagnostics on Mac computers with Apple silicon. Diagnostics are critical to properly diagnose, troubleshoot, repair, and validate a repair for Mac computers.

## Contents of this article:

- [Overview](#)
- [What's New](#)
- [AST 2 Diagnostic Console Categories](#)
- [Diagnostics Required Based on Repair Procedure](#)
- [Additional Resources](#)

## Overview

Understanding the difference between a diagnostic suite, a diagnostic test, and a diagnostic tool, will help you determine which is most appropriate to run and when, depending on the stage of the repair process. The fundamental aspects of diagnostics include:

- **Apple Service Toolkit 2 (AST 2):** a cloud-based system that contains the diagnostic suites, tests, and tools.
- **AST 2 Diagnostic Console:** a web application used to initiate the diagnostic suites and tools on a user's device, as well as view the results of each.
- **Suite:** a collection of tests that are run at the same time.
- **Test:** single test for a specific part or feature.
- **Tool:** used to complete a repair or perform a specific task.

## What's New

A new infrastructure for AST 2, similar to what's available for iOS, enables simpler, faster, and easier to use diagnostics for Mac computers with Apple silicon. The process of running diagnostics is similar to previous Intel-based Mac computers, however there are new features and benefits specific to Mac computers with Apple silicon:

- User-friendly interface to enter Diagnostics Mode. Hold the power button for 10 seconds to get to Startup Options, then hold Command + D.
- Wi-Fi is now the standard connection method since AST 2 can now interact with frameworks installed in macOS Recovery. Ethernet can still be used.
- OS based diagnostics are often faster than the EFI diagnostics required for Intel-based Mac computers.
- All diagnostics are OS based.
- Many interactive prompts now appear on the user's computer instead of the AST 2 Diagnostic Console.
- Similar to iOS, the AST 2 Diagnostic Console has been streamlined into the following three categories:
  - Triage
  - Tools
  - Post-Repair

## AST 2 Diagnostic Console Categories

### Triage

The Triage category of the AST 2 Diagnostic Console contains suites intended to quickly identify, confirm, and verify potential hardware issues. It's important to remember that Triage doesn't just take place at the beginning of a repair. You may replace a part and then discover a new issue. You'll need to use the Triage diagnostics to identify the part causing the new issue. The following quick checks can be run with the user to help confirm the reported hardware issue.

**Important:** Run MRI anytime a computer will be checked in for repair.

- MRI
- Display Anomalies
- Image Persistence
- Keyboard
- Power Adapter
- Touch ID
- Touch Bar Response
- Touch Bar Pixel Anomalies
- Trackpad
- Cooling System
- Graphics and Display
- Audio
- Memory
- Full System Diagnostic

**Note:** Full System Diagnostic can be run prior to a repair to help you identify intermittent hardware issues.

## Tools

The Tools category contains the [System Configuration suite](#) (TP1901) which must be run to complete a repair of a display, logic board, top case, or Touch ID board.

## Post-Repair

The Post-Repair category contains the diagnostic suites used to validate a repair, such as Post-Repair Diagnostic and Trackpad Calibration Check.

## Diagnostics Required Based on Repair Procedure

After completing a repair on a Mac with Apple silicon, consult the charts below to determine which post-repair diagnostics to run.

### Mac Notebooks with Apple Silicon

Module	Repair Completion	Post-Repair Verification
Audio Board Audio Board Flex Assembly Audio Board Flex Cable	—	<ul style="list-style-type: none"> <li>• Audio</li> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Battery	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
BMU Flex Cable	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Bottom Case	—	<ul style="list-style-type: none"> <li>• MRI</li> <li>• Trackpad Calibration Check</li> </ul>
Display	<ul style="list-style-type: none"> <li>• <a href="#">System Configuration</a></li> </ul>	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
eDP Flex Cable	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Fan(s)	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
I/O Board	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
IPD Flex Cable	—	<ul style="list-style-type: none"> <li>• MRI</li> <li>• Keyboard</li> <li>• Trackpad Calibration Check</li> </ul>
Logic Board	<ul style="list-style-type: none"> <li>• <a href="#">System Configuration</a></li> <li>• Use <a href="#">Apple Configurator 2</a> (TP1954) to update firmware and install latest macOS.</li> </ul>	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Speakers	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Top Case	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Keyboard</li> <li>• Trackpad</li> <li>• Touch Bar Response</li> <li>• Touch Bar Pixel Anomalies</li> <li>• Trackpad Calibration Check</li> </ul>
Top Case with Battery	<ul style="list-style-type: none"> <li>• <a href="#">System Configuration</a></li> </ul>	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Keyboard</li> <li>• Trackpad</li> <li>• Touch Bar Response</li> <li>• Touch Bar Pixel Anomalies</li> <li>• Trackpad Calibration Check</li> </ul>
Touch ID Board	<ul style="list-style-type: none"> <li>• <a href="#">System Configuration</a></li> </ul>	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Touch ID</li> <li>• Trackpad Calibration Check</li> </ul>
Touch ID Shim	—	<ul style="list-style-type: none"> <li>• MRI</li> <li>• Touch ID</li> <li>• Trackpad Calibration Check</li> </ul>
Trackpad Trackpad Flex Cable	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Vent/Antenna Module	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>



**Mac Desktops with Apple Silicon**

Module	Repair Completion	Post-Repair Verification
Antenna Plate	—	• MRI
Bottom Cover	—	• MRI
Coin Cell Battery	—	• Post-Repair Diagnostic
Fan(s)	—	• Post-Repair Diagnostic
Housing	—	• Post-Repair Diagnostic
I/O Wall	—	• Post-Repair Diagnostic
Logic Board	<ul style="list-style-type: none"><li>• <a href="#">System Configuration</a></li><li>• Use <a href="#">Apple Configurator 2</a> (TP1954) to update firmware and install latest macOS.</li></ul>	• Post-Repair Diagnostic
Power Supply	—	• Post-Repair Diagnostic
Speakers	—	• Post-Repair Diagnostic

# MacBook Pro (13-inch, M1, 2020) Serial Number Locations

The system serial number and model number are located on the bottom case. Turn over the computer to view the numbers etched on the bottom case near the hinge.

**Note:** Bar code readers can be used to read serial numbers inside the computer.

**Model Number:** A2338

**EMC Number:** 3578



## Transferring the System Serial Number

When replacing a bottom case, retain the user's original bottom case until the repair is complete. Before installing a replacement bottom case, use a fine-tip permanent marker to write the original system serial number inside the bottom case.



### Battery Serial Number

Copy the original battery serial number when reporting a top case return to Apple. Do not copy the replacement serial number.

The battery serial number, located underneath the trackpad flex cable, is shown below. Carefully peel back the trackpad flex cable to view the battery serial number.



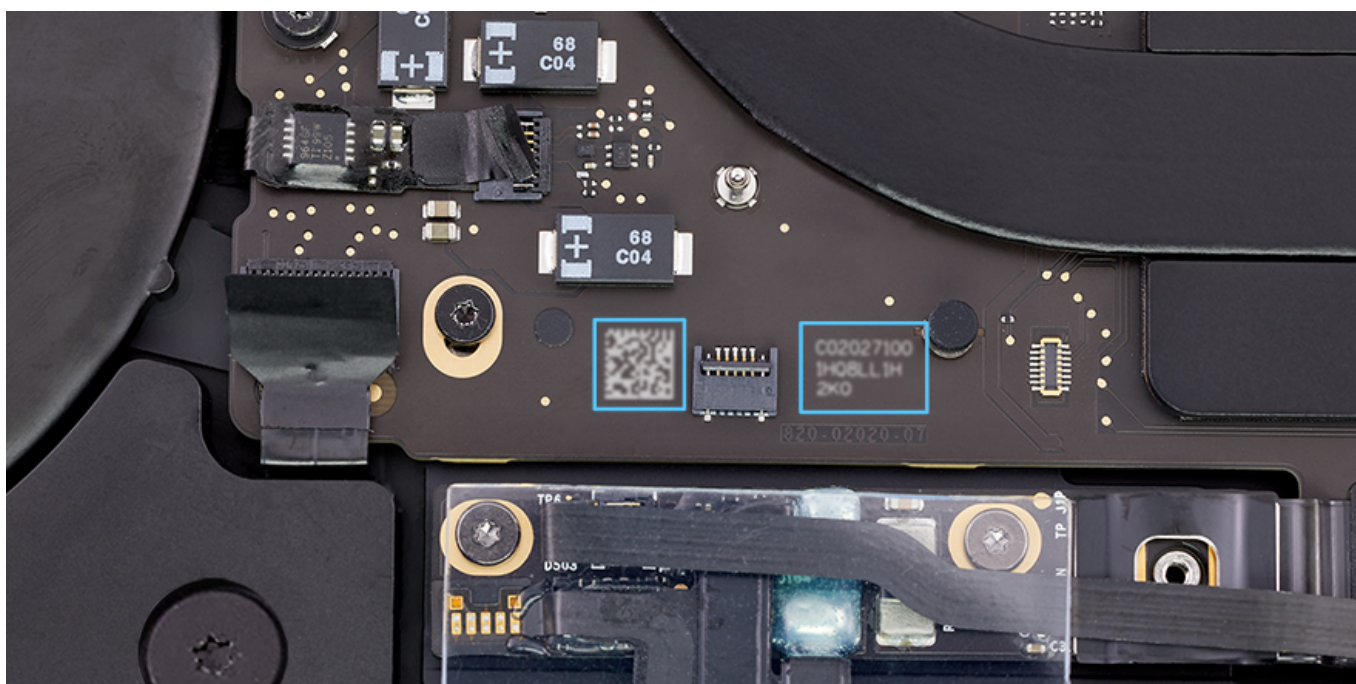
### Display Assembly Serial Number

The display assembly serial number is located on the TCON board.



### Logic Board Serial Number

The logic board serial number is located on the lower left corner of the logic board.



# Portables (Mid 2012 and later) Battery Safety Setup

## Battery Safety Setup for MacBook, MacBook Air, and MacBook Pro (Mid 2012 and later)



**Warning:** Before servicing a portable computer, read and understand [Safely handling lithium batteries and lithium battery-powered devices](#).

For information on how to set up your workstation, refer to [Embedded battery workstation setup for Apple notebook computers and iPhone](#).



# MacBook Pro (16-inch, 2019), MacBook Pro (13-inch, 2020), MacBook Pro (13-inch, M1, 2020), MacBook Air (Retina, 13-inch, 2020), and MacBook Air (M1, 2020) Keycap Replacement

Keycap Replacement for the following models that use the scissor mechanism for the keycaps:

- MacBook Pro (16-inch, 2019)
- MacBook Pro (13-inch, 2020, Two Thunderbolt 3 Ports)
- MacBook Pro (13-inch, 2020, Four Thunderbolt 3 Ports)
- MacBook Pro (13-inch, M1, 2020)
- MacBook Air (Retina, 13-inch, 2020)
- MacBook Air (M1, 2020)



This is the quickest and most cost-effective procedure for fixing the following symptoms:

- Key stuck in up or down position
- Key press feels uneven or stiff
- Keycap not responding

The procedure involves three basic steps:

**Note:** This procedure may seem familiar, however there are some important differences. Always be sure that the lever tool is pointing in the proper direction. For direction, see the map below.

1. Applying the adhesive to the keycap lever tool.
2. Pressing and holding the keycap lever tool on the keycap for 10 seconds.
3. Pulling the keycap in the correct direction to release snaps.



For video instruction, refer to [SV421: Keycaps Replacement](#).

For part numbers, refer to the [Keycap Kit Part Numbers](#) section below.

For the correct scissor to use, refer to the [Scissor Map](#) section below.

For detailed information on the procedure, refer to the [Procedure for Removing and Replacing Keycaps](#) section below.

**Note:** If a keycap replacement does not resolve the issue, you must replace the entire top case. To confirm the correct keyboard country code and part number, refer to [HT201794: How to identify keyboard localizations](#). Use the exploded view in the service guide to confirm the correct top case part number before ordering a service part.

## First Steps

- Before replacing the keycap on an unresponsive keyboard, be sure to clean the keyboard thoroughly with compressed air. Then remove the keycap, spray the well with compressed air, and check for liquid damage.
- Always install a new keycap. Do not attempt to reinstall the keycap that was removed.

### 1. Keycap Kit Part Numbers

**Important:** Keycap kits vary by computer color and keyboard language.

To help determine keyboard localization or keycap placement, refer to [HT201794: How to identify keyboard localizations](#).

#### Keycap Kits:

- Keycap kits are available for UK English (ISO), Arabic (ISO), U.S. English (ANSI), Chinese (ANSI), Korean (ANSI), and Japanese (JIS) version keyboards.
- The ISO Superkit is a European special character kit that, **when combined with the British (ISO) kit**, supplies keycap characters for the languages below. Click each language for ISO Superkit mapping.
  - [Croatian](#)
  - [Danish](#)
  - [Dutch](#)
  - [French](#)
  - [German](#)
  - [Hungarian](#)



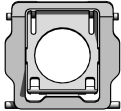
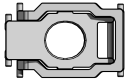
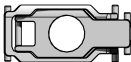
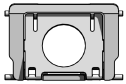
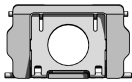
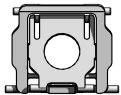
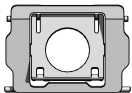
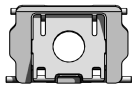
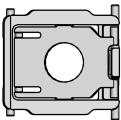
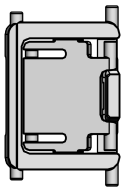
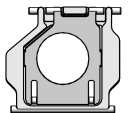
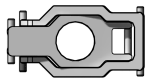
- [Icelandic](#)
- [International Z](#)
- [Italian](#)
- [Norwegian](#)
- [Portuguese](#)
- [Romanian](#)
- [Spanish](#)
- [Swiss French](#)
- [Swedish](#)
- [Turkey](#)
- [Turkish Q](#)
- Common Kits include the following keycaps:
  - ANSI: Space bar, Left Shift, Right shift, Caps Lock, Delete, Tab, Return, Escape
  - JIS: Space bar, Return, Left Shift, Right Shift, Delete, Escape, and Tab
  - ISO: Space bar, Right Shift, Caps Lock, Delete, Tab, Return, Escape

Keycap kits are shared across all models listed at the top of this article. *The MacBook Air (Retina, 13-inch, 2020) has an additional set of keycaps for the function row (923-03429).*

Part Number	Label Number	Language
923-03854	605-06246	US English (ANSI)
923-03855	605-06247	ANSI Common Keys
CH923-03854	CH605-06246	Chinese (ANSI)
KH923-03854	KH605-06246	Korean (ANSI)
B923-03854	B605-06246	British English (ISO)
ZM923-03854	ZM605-06246	ISO Superkit
ZM923-03855	ZM605-06247	ISO Common Keys
J923-03854	J605-06246	Japanese (JIS)
J923-03855	J605-06247	JIS Common Keys
AB923-03854	AB605-06246	Arabic (ISO)
FE923-03855	FE605-06247	Far East Common Keys
923-03429	605-00253	MacBook Air Function Row

## 2. Scissor Map

There are 11 different scissor types in the scissor kit (923-03863). The MacBook Air (Retina, 13-inch, 2020) has an additional function row scissor that ships with the function row keycaps (923-03429). Use the maps below to see which scissor to use if it is necessary to replace a scissor. A scissor only needs to be replaced if it is broken.

Symbol	Scissor
A1	
B1	
C1	
D1	
E1	
F1	
G1	
H1	
I1	
J1	
K1	
L1 MacBook Air (Retina, 13-inch, 2020) only	

The symbols on the map below correspond to the symbol on the scissor bag. Orange indicates where the snaps

**Note:** MacBook Air (Retina, 13-inch, 2020) keyboard has an additional row of keys.

### 3. Procedure for Removing and Replacing Keycaps

**Caution:**

- Shut down the computer before replacing a keycap.
- Press the keycap lever very gently on the keycap when initializing the VHB adhesive strip. The top case should not bend when pressing the keycap lever onto the keycap.
- Only the keycaps and scissors are replaceable. A damaged dome or metal hooks requires a top case replacement.
- Check the rubber dome and raised metal areas inside the keycap well.
  - When the rubber dome is pressed and released, it should spring back upright. If the rubber dome is off center or damaged, replace the top case.
  - If the metal hook that holds the slider bar of the scissor mechanism is bent, try to bend it back to a uniform 90-degree angle. If it is bent or broken beyond repair, replace the top case.
  - If the two metal ears are bent, use needlenose pliers to straighten them. If either or both ears are broken beyond repair, replace the top case.

**Tools:**

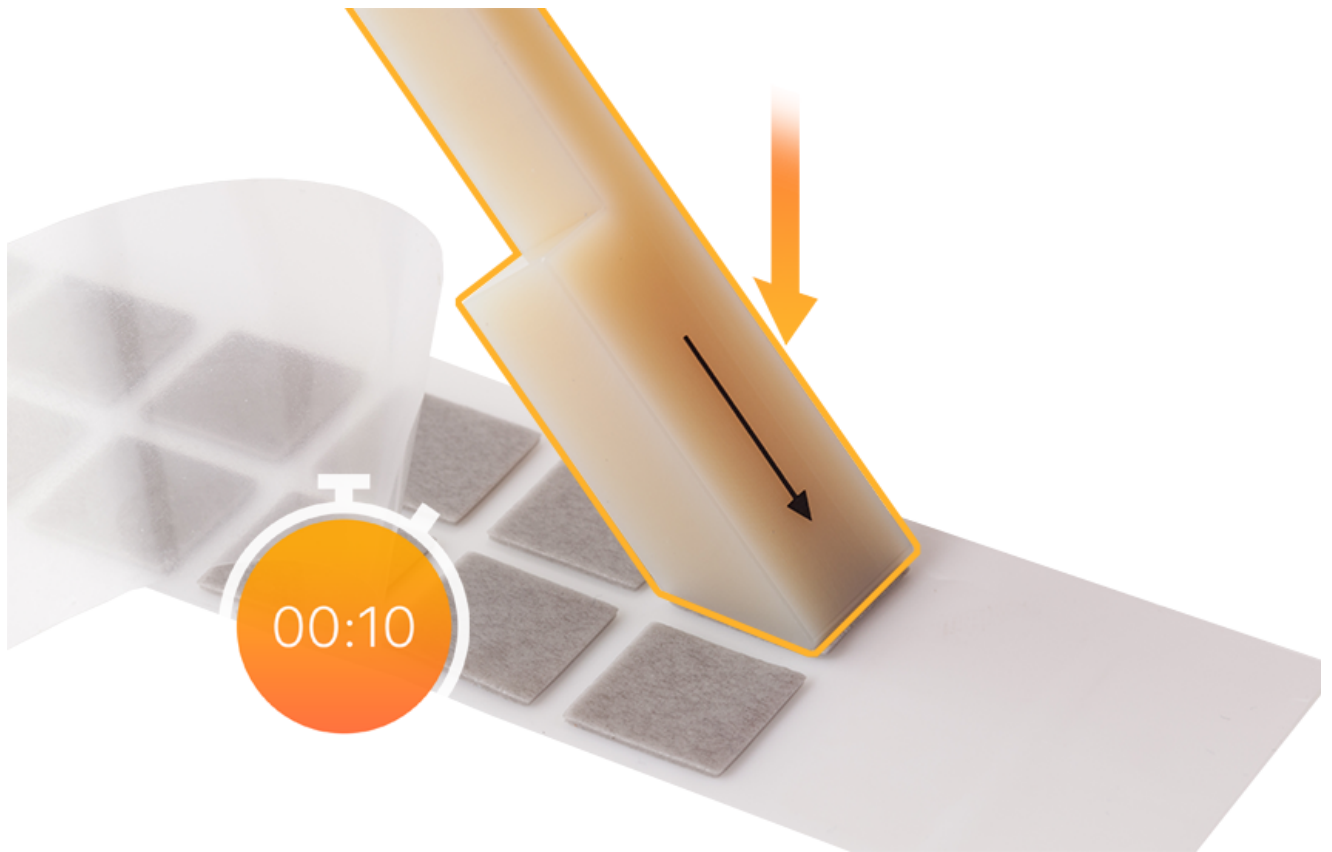
- Compressed air
- Precut VHB Strips (923-01801, 1x1; 923-01800, 1x.5)
- Keycap Lever (923-01803) **Note:** This tool is double sided. The smaller side is used for the arrow keys and Escape key.
- Keycap Lever Kit (076-00457) includes: Keycap lever and precut VHB strips
- Black stick
- ESD-safe tweezers

Follow these steps to remove and replace a keycap.

Each type of key on the keyboard requires a specific procedure.

**A. Removing and Replacing 1x1 keys****Removal**

1. Peel back the frosted liner from one side of the precut VHB strip. Press the large end of the keycap lever onto the 1x1 adhesive and hold for 10 seconds.



2. Lift the keycap lever, with the adhesive attached, from the clear liner.

3. Lightly press the keycap lever with the adhesive side down onto the key. **Important:** The arrow on the lever must always point to the hinged side of the keycap (toward the display) so the lever is always tilting away from the snaps and toward the hinge. Refer to the Scissor Map above for the location of the snaps. **Note:** The Caps Lock key on the JIS keyboard is different. Be sure to refer to the map.

4. Hold for 10 seconds to activate the adhesive.

**Note:** The adhesive is very strong. If the keycap lever is accidentally placed onto the wrong keycap, continue with the removal process and replace with a new keycap.





check that it moves easily and lies flat when released. For easier inspection, turn on the keyboard backlight to illuminate the scissor.



7. Use compressed air to clean the keycap well. **Note:** If compressed air does not dislodge visible debris, use a black stick to gently dislodge the debris.

8. Remove the keycap and the adhesive from the keycap lever and discard both. **Note:** The adhesive is one-time use only and must be replaced for every keycap removal.

### Reassembly

**Important:** Always replace the removed keycap with a new one. Do not reuse keycaps.

1. Insert the hinged side of the keycap into the well at a 15-degree angle and gently push to engage the hinges.





2. Gently push down on the top of the keycap to engage the snaps.



3. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the response of the keycaps around it.

4. If the keycap does not appear to be correctly installed, start again at removal step one with a new keycap.

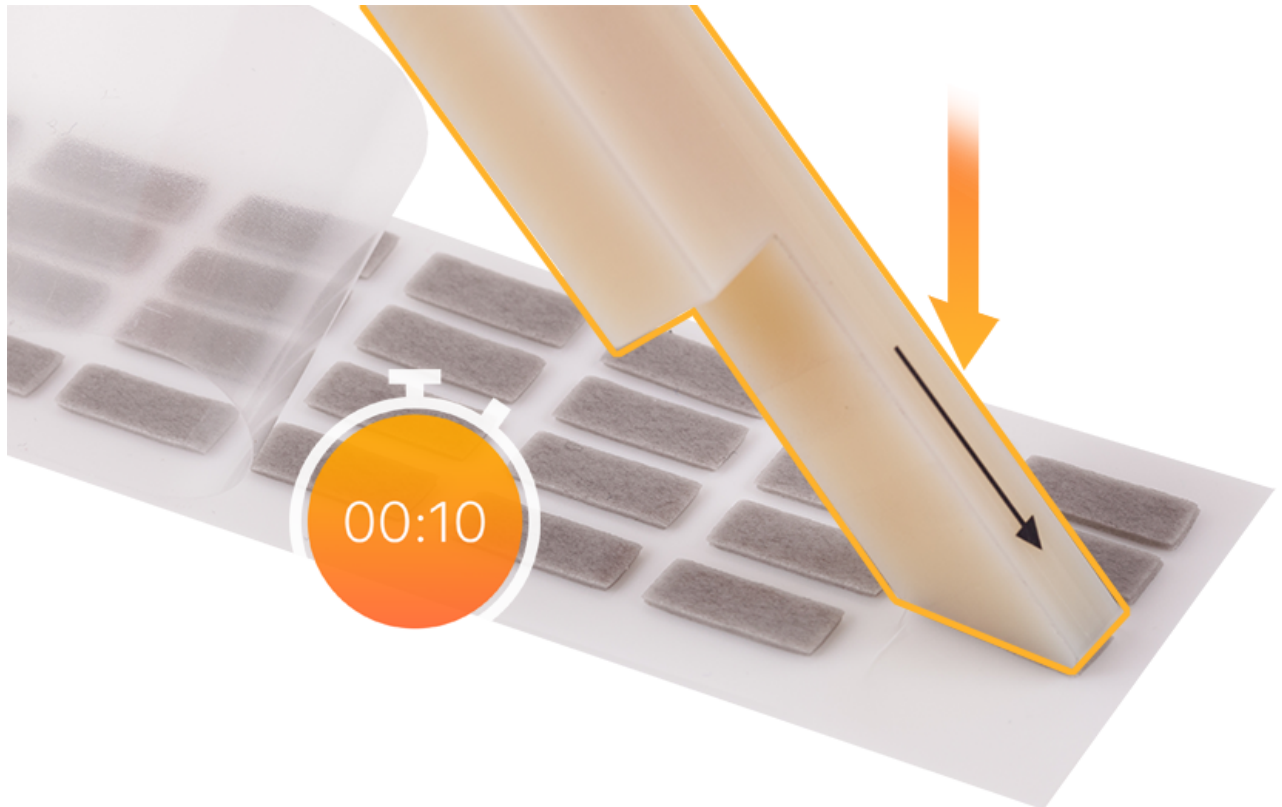
## B. Removing and Replacing Arrow Keys and the Escape Key

### Important:

- For the bottom row arrow keys, the hinges are on the left, so the arrow on the lever tool points toward the left.
- For the up arrow key and the escape key the hinges are on the right, so the lever tool arrow points toward the right.

### Removal

1. Peel back the frosted liner from one side of the precut VHB strip. Press the small end of the keycap lever onto the 1x.5 adhesive and hold for 10 seconds.



2. Lift the keycap lever, with the adhesive attached, from the clear liner.

3. Lightly press the keycap lever with the adhesive side down onto the key. **Important:** The arrow on the lever must always point to the hinged side of the keycap so the lever is always tilting away from the snaps and toward the hinge. Refer to the Scissor Map above for the location of the snaps.

4. Hold for 10 seconds to activate the adhesive.

**Note:** The adhesive is very strong. If the keycap lever is accidentally placed onto the wrong keycap, continue with the removal process and replace with a new keycap.

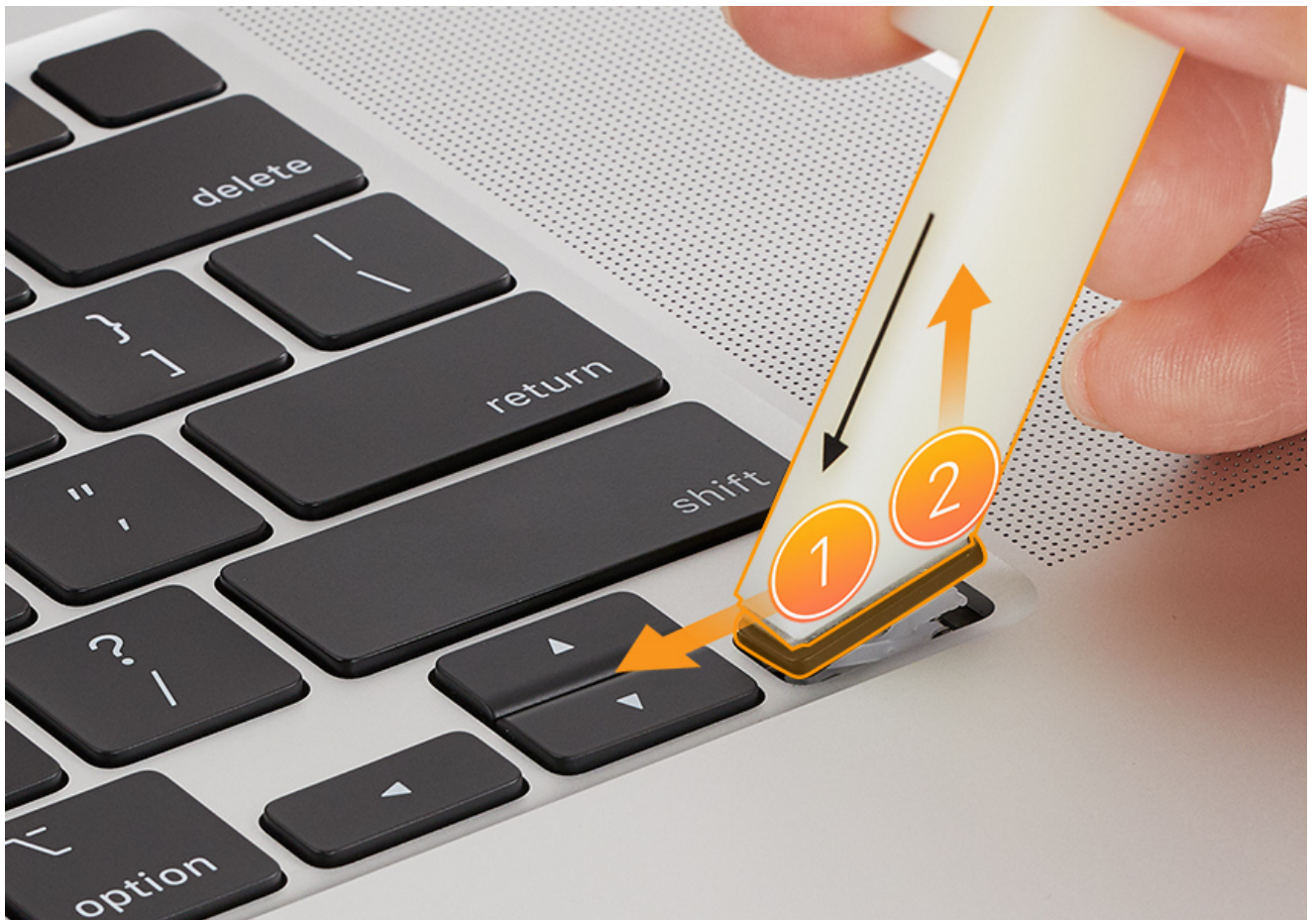




5. Push the lever tool towards the arrow and lift up just until you hear a snap. **Caution:** Be sure not to tilt the keycap more than 20 degrees. Doing so could cause the scissor mechanism to become damaged.



6. Push toward the left to release the keycap from the hinges (1). Lift up to remove the keycap (2).



7. Remove the keycap and the adhesive from the keycap lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

### Reassembly

**Important:** Always replace the removed keycap with a new one. Do not reuse keycaps.

1. Use a black stick to lift the scissor slightly. Insert the hinged side of the keycap into the well at a 15-degree angle and then slide the key back toward the snap to engage the hinge. **Note:** This process is unique to the arrow keys and the Escape key.





2. Gently push down on the top of the keycap to engage the snaps.

3. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the response of the keycaps around it.

4. If the keycap does not appear to be correctly installed, start again at removal step one with a new keycap.

### **C. Removing and Replacing Link Bar Keys (Space Bar, Tab, Return, Shift, Delete, and Caps Lock)**

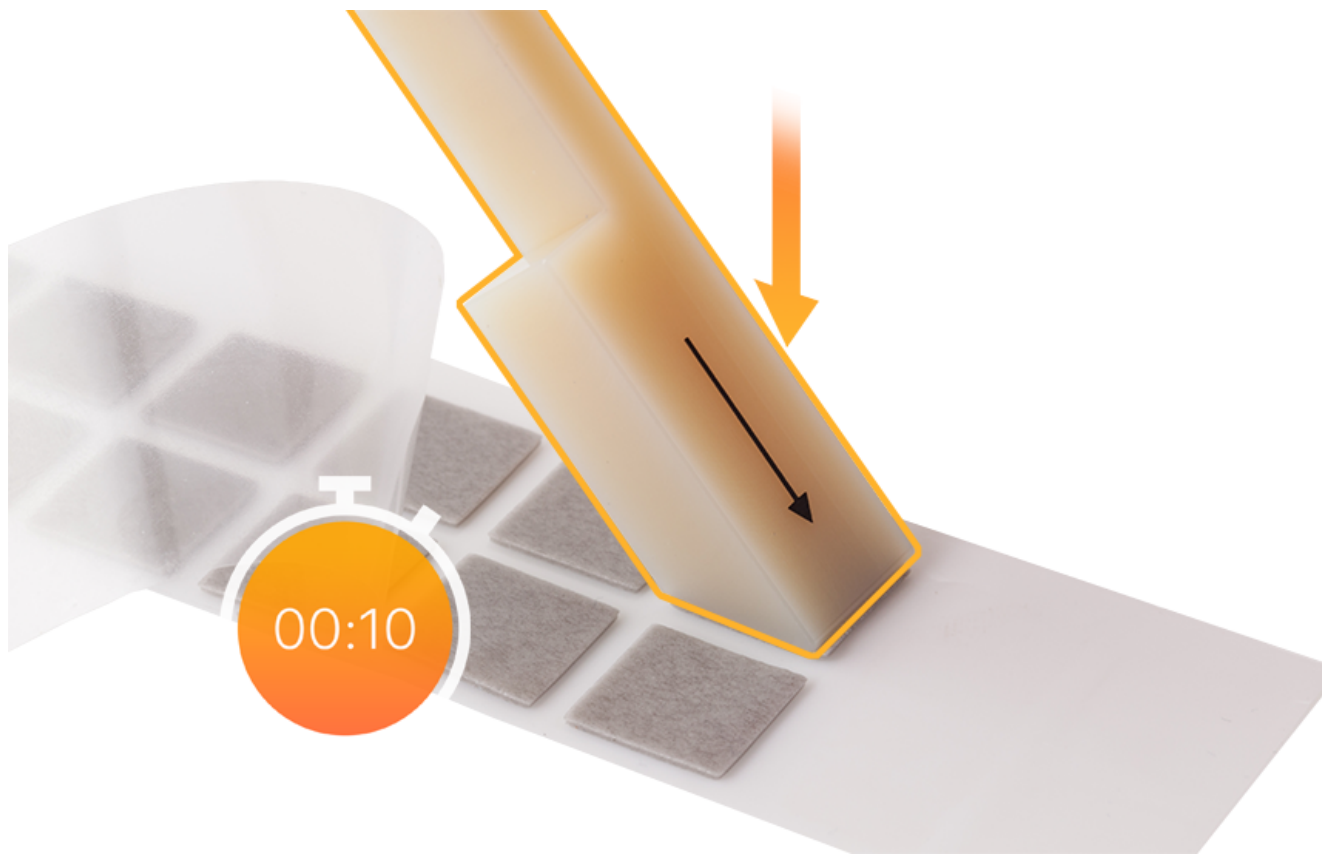
#### **Note:**

- For keys with two hinges and two snaps, use two keycap lever tools. Refer to the scissor map.
- Space bar, tab, return, shift, delete, and Caps Lock keys have link bars. The process for keys with link bars is the same. Refer to the scissor map for the link bar locations.

#### **Removal**

1. Align the lever tool over each set of scissors. Refer to the scissor map for correct placement.

2. Peel back the frosted liner from one side of the precut VHB strip. Press the large end of one the keycap lever onto the 1x1 adhesive and hold for 10 seconds. Repeat for the second lever.



3. Lift the keycap levers, with the adhesive attached, from the clear liner.

4. Lightly press the keycap lever with the adhesive side down onto the key. **Important:** The arrows on the levers must always point to the hinged side of the keycap so the levers are always tilting away from the snaps and toward the hinge. Refer to the Scissor Map above for the location of the snaps.

5. Hold for 10 seconds to activate the adhesive. **Note:** The adhesive is very strong. If the keycap lever is accidentally placed onto the wrong keycap, continue with the removal process and replace with a new keycap.



6. Simultaneously lift both levers in the direction of the arrow until you hear the snaps release. Then lift the keycap off of the keyboard. **Note:** The bottom link bar on larger keys might stick to the keycap during removal. If so, use a black stick to unsnap it so it stays in the keycap well.



7. Once the keycap has been removed, use a black stick to carefully and gently lift each scissor up and down to check that they move easily and lie flat when released. For easier inspection, turn on the keyboard backlight to illuminate the scissors.



8. Use compressed air to clean the well. **Note:** If compressed air does not dislodge visible debris, use a clean cloth to gently dislodge the debris.

9. Remove the keycap and the adhesive from the keycap lever and discard both. Note: The adhesive is one-time use only and must be replaced for every keycap removal.

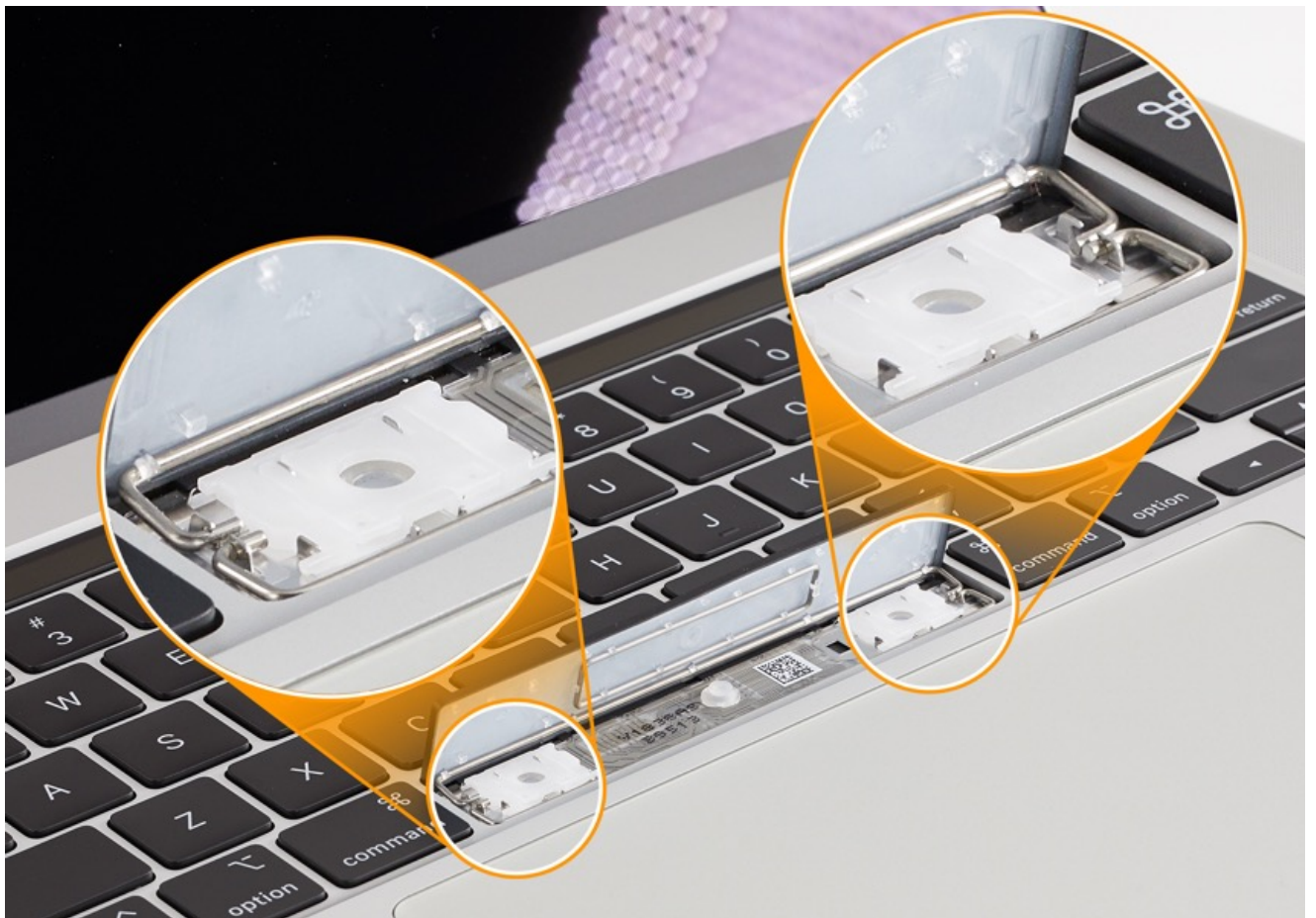
### Reassembly

**Important:** Always replace the keycap with a new one. Do not reuse keycaps.

1. Check that the hinge bar is preinstalled on the replacement keycap. The snap bar remains in the top case.



2. Position the keycap at a 15-degree angle and insert the top link bar into the metal hooks located on each side of the well.



3. Push the key forward to set the bar in place. Then gently push down on the four snaps to engage the keycap.



4. If the keycap does not appear to be correctly installed, start again at removal step one with a new keycap.

#### D. Replacing Scissors

**Important:**



- Only remove the scissor if the scissor is damaged. Be sure to replace it with the correct type of scissor. Refer to the scissor map to find the correct scissor.
- Be sure to take note of the correct orientation of the scissor. This will be important for reassembly.

1. Use a black stick to disengage the scissor pins from the metal hooks.



2. Once the pins are disengaged, use tweezers to lift the scissor out of the well.



## Reassembly

### Important:

- Before installing a new scissor, check the scissor map to ensure you are installing the correct one.
- Be sure the scissor is installed in the correct orientation.

1. Use compressed air to clean the keycap well. **Note:** If compressed air does not dislodge visible debris, use a black stick to gently dislodge the debris.

2. Use tweezers to align the scissor in the well and engage the upper hooks.



3. Engage the scissor pins with the lower hooks with your finger or a black stick. When engaged the pins should look like number 1. Number 2 shows the pin not engaged.



4. Once the scissor has been installed, use a black stick to carefully and gently lift the scissor up and down to check that it moves easily and lies flat when released. For easier inspection, turn on the keyboard backlight to illuminate the scissor.

# Common Troubleshooting Procedures for Mac Computers with Apple Silicon

**Caution:** Apple recommends that users [back up their data](#) before attempting any software troubleshooting. Essential files should be backed up before installing or reinstalling macOS. Apple is not responsible for any loss of data.

Before you begin troubleshooting, have the user attempt to reproduce the issue, then attempt to reproduce the issue yourself. Attempt the common troubleshooting procedures in the order listed in the table below.

Always refer to the troubleshooting procedures listed in the Service Guide of the Mac you're troubleshooting.

**Important:** The following steps may not be effective for all issues. Apply only the steps necessary to isolate and resolve the user's issue.



Procedure	Action
<b>Minimal Risk for Data Loss</b>	
<b>Charge Battery</b>	For Mac notebooks, connect to a known-good power outlet, using a known-good Apple Power Adapter and charge cable to charge the battery for at least 15 minutes. Note: Use the appropriate wattage power adapter.
<b>Log Out</b>	Simple issues may be resolved by logging out, then logging back in to the user account.  Deselect "Reopen windows when logging back in" to close the app windows that are currently open.
<b>Restart</b>	Restarting closes all open applications, turns off all hardware components, then restarts the Mac. A restart can quickly resolve a wide range of issues, including the following: <ul style="list-style-type: none"> <li>• Apps unexpectedly quit.</li> <li>• Battery life is shorter than expected.</li> <li>• Hardware is not performing as expected.</li> <li>• Interface or apps are slow to respond.</li> </ul>
<b>Shutdown (Reset)</b>	For notebooks with Apple silicon, turn off the Mac, then wait 15 seconds before you turn it back on.  For desktops with Apple silicon, turn off the Mac. Unplug the power cord for 15 seconds, then reconnect the power cord. Wait 5 seconds, then turn it back on.
<b>Safe Mode</b>	<a href="#">Start up in Safe Mode</a> (HT201262) to verify that the computer can startup completely without any issues.
<b>Update Software</b>	Check for and apply the latest software and firmware updates. Retest for the user's original issue before continuing with further troubleshooting.
<b>Check if in DFU mode</b>	Press and hold the power button for 10 seconds to attempt to shut down the computer. Then press the power button again to attempt to turn on the computer. If the computer turns on, then it was in DFU mode and has power.
<b>Greater Risk for Data Loss</b>	
<b>Repair Disk</b>	Start up to macOS Recovery and use <a href="#">Disk Utility</a> (HT210898) to attempt to repair a volume that may be exhibiting issues.
<b>Reinstall</b>	Use macOS Recovery to <a href="#">reinstall macOS</a> (HT204904) while preserving the data on the user volume.
<b>Revive</b>	In some circumstances, such as a power failure during a macOS upgrade, a Mac may become unresponsive and so the firmware must be revived. A Revive updates the firmware and macOS Recovery to the latest version. A Revive is designed to not make any changes to the startup volume, the user's data volume or any other volumes.  Refer to the Revive steps in the <a href="#">Apple Configurator 2 User Guide</a> . For additional details, refer to <a href="#">TP1954: When you Use Apple Configurator 2</a> .
<b>Data Loss Will Occur</b>	
<b>Erase Disk</b>	If you can't access the startup volume, or user's data volume, and you've already attempted a revive using Apple Configurator 2, use Disk Utility in macOS Recovery to erase the startup volume, user's data volume, or any other volumes.
<b>Restore</b>	If the computer can't start up to either macOS or macOS Recovery, follow the Restore instructions in the <a href="#">Apple Configurator 2 User Guide</a> to restore the firmware and install the latest versions of macOS and macOS Recovery. When this process is complete, any data on any internal volumes is unrecoverable. For additional details, refer to <a href="#">TP1954: When to Use Apple Configurator 2</a> .

# Startup Options and macOS Recovery for Mac Computers with Apple Silicon

This article contains details about startup options and macOS Recovery for Mac computers with Apple silicon.

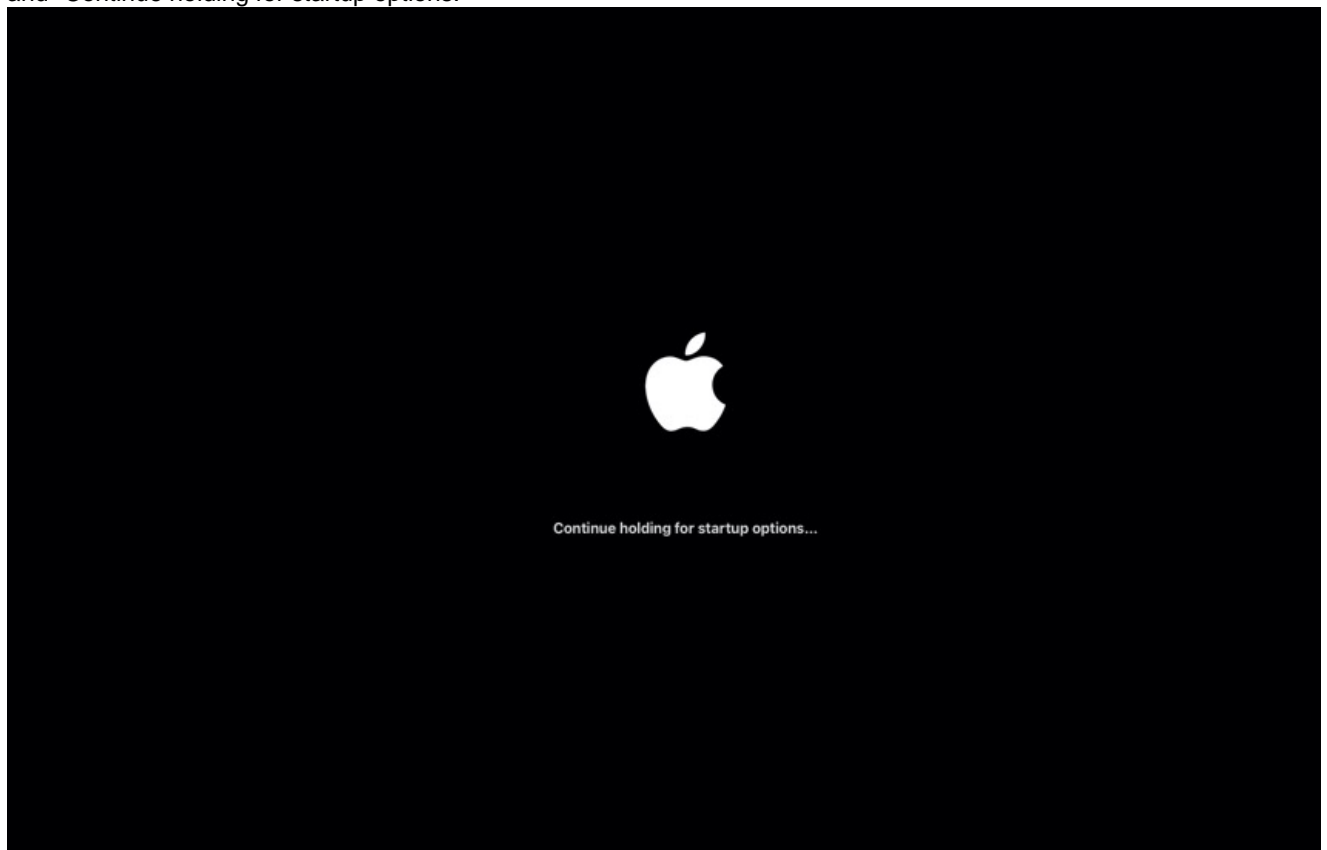
## Contents of this article:

- [Startup Options](#)
- [Startup Disk](#)
- [Safe Mode](#)
- [macOS Recovery](#)
- [Diagnostics Mode](#)
- [Disk Sharing](#)

**Caution:** Apple recommends that users [back up their data](#) before attempting any software troubleshooting. Essential files should be backed up before installing or reinstalling macOS. Apple is not responsible for any loss of data.

Startup options looks similar to Startup Manager on Intel-based Mac computers, but there are several differences. You can use startup options to do the following:

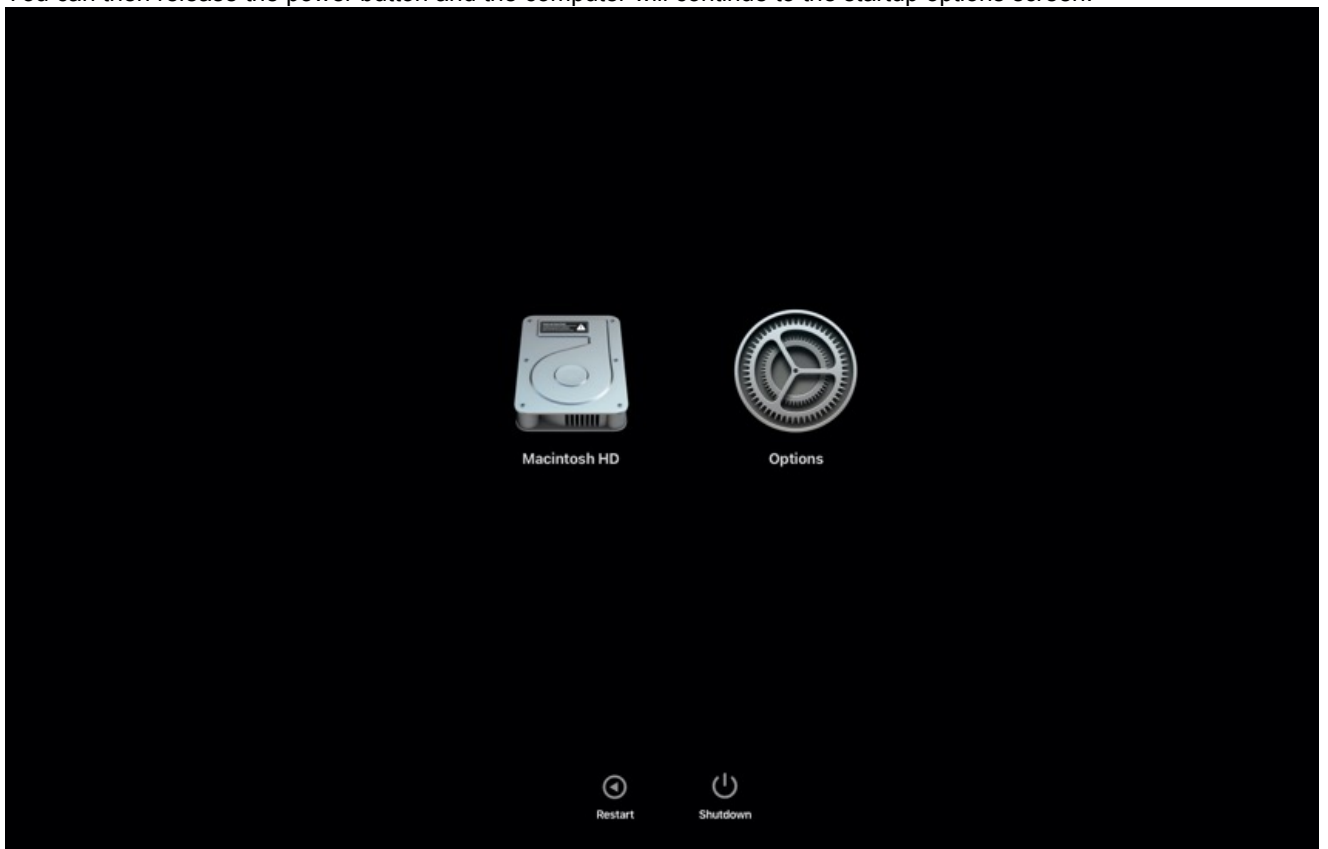
- Select a different startup disk
  - Start up in Safe Mode
  - Start up in macOS Recovery
  - Start diagnostics
1. On a Mac with Apple silicon, press and hold the power button. After 5 seconds, the Mac will display an Apple logo ( ) and "Continue holding for startup options."



2. Continue holding the power button. The Mac will display an Apple logo ( ) and "Loading startup options."



3. You can then release the power button and the computer will continue to the startup options screen.



## Startup Disk

- To choose a different startup disk, select the desired startup disk, then click "Continue."
- To set a default startup disk, select the desired startup disk, press the Option or Control key, then click "Always Use."
- Multiple versions of macOS can be installed.

## Safe Mode

- From startup options, select the startup disk, then hold Shift. Click "Continue in Safe Mode" to start up the Mac in [Safe Mode](#) (HT201262).

## macOS Recovery

- Choose the Options gear icon to start up in macOS Recovery.
- macOS Recovery is now a complete version of macOS, so features such as VoiceOver are fully supported.
- You'll always get the latest signed version of macOS.
- An internet connection is required to reinstall macOS.

## Diagnostics Mode

1. Press and hold the Command and D keys. After a few seconds, the screen will display "Continue holding to start diagnostics."



2. Continue holding the two keys until the computer starts up to Diagnostics mode.

## Disk Sharing

- Disk Sharing takes the place of Target Disk Mode, but significantly improves on security because a password is required every time a user wants to access their data on another computer.
- A Thunderbolt or USB-C cable is required.
- Big Sur is not required for the host Mac.

## Visual/Mechanical Inspection (VMI) Guide for Mac - Table of Contents

- [Displays](#)
- [Liquid Contact](#)
- [Notebook Power Adapters](#)
- [Notebook USB-C Cables](#)



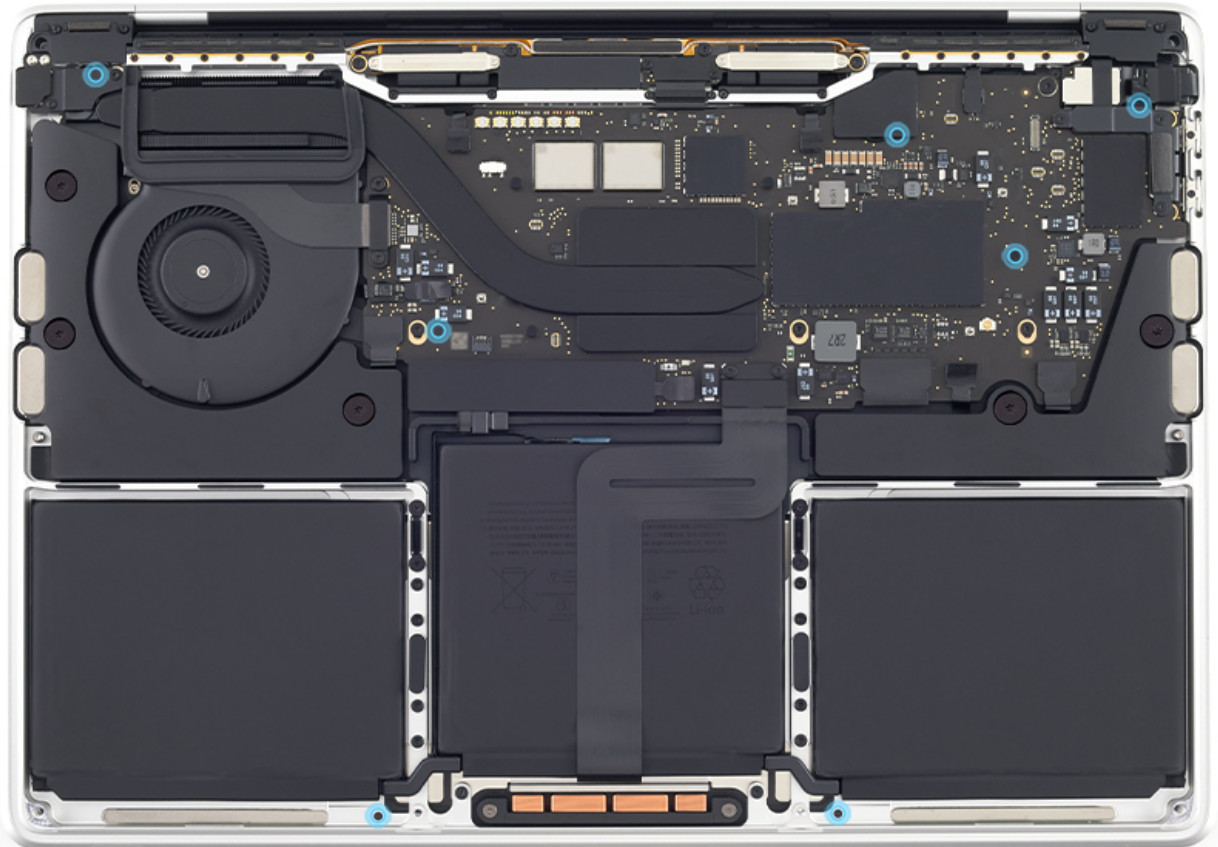
## MacBook Pro (13-inch, M1, 2020) Liquid Contact Indicators

Liquid Contact Indicators (LCIs) help determine if a computer has been exposed to liquid. Represented by [small black \(Ultraviolet LCIs\) dots](#) (TP1557), LCIs change color when they come in contact with liquid, such as an accidental spill.

**Important:** An LCI is a tool that helps technicians identify if a product has been in contact with liquid. Technicians should not rely solely on this tool, but should perform a thorough examination for signs of liquid contact, such as corrosion.

For more information, refer to [Mac computers: About liquid contact indicators \(LCIs\) and warranty coverage](#).

- The circle in the top left corner represents a UV LCI that is visible under the Touch ID board cowling.



# How to Read Liquid Contact Indicators with Ultraviolet (UV) Light

## How to Read Liquid Contact Indicators with Ultraviolet (UV) Light

MacBook (Retina, 12-inch, 2017), MacBook Air (Retina, 13-inch, 2018 and 2019), MacBook Air (M1, 2020), MacBook Pro (2018, 2019, and 2020), and MacBook Pro (13-inch, M1, 2020) contain spill sensors called liquid contact indicators (LCIs). LCIs help discover accidental damage to the computer. They are black, and liquid contact is only visible with the use of a UV light. LCIs appear black under normal light and glow blue when highlighted with a UV light. They turn pink or produce a pink halo when they come in contact with liquid.

**Note:** MacBook Pro (15-inch, 2018 and 2019) also has one LCI that appears white and turns pink when it comes in contact with liquid. Refer to [TP1660: Liquid Contact Indicators](#).

For more information, refer to [HT204769: About liquid contact indicators \(LCIs\) and warranty coverage](#).

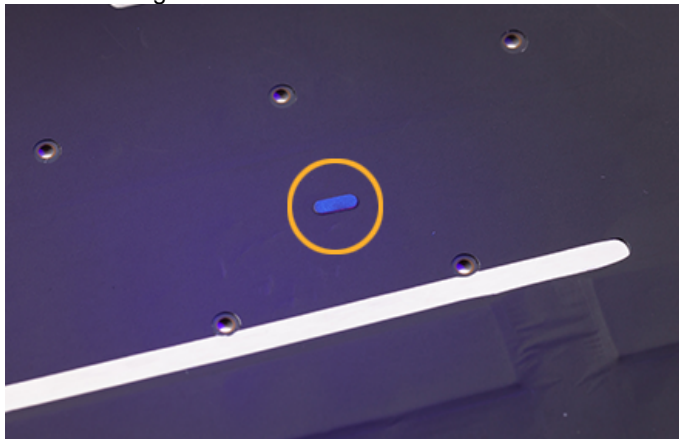
**Important:** A triggered LCI is not the only evidence of liquid contact. Be sure to inspect for corrosion or liquid residue during a quick check or repair.

### No Liquid Contact:

- LCI without UV light

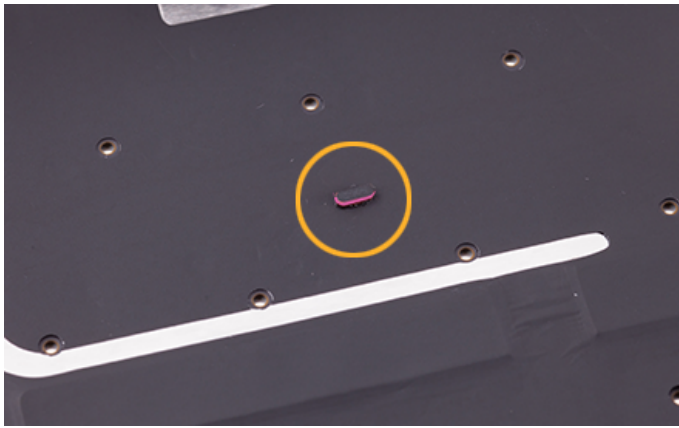


- LCI with UV light

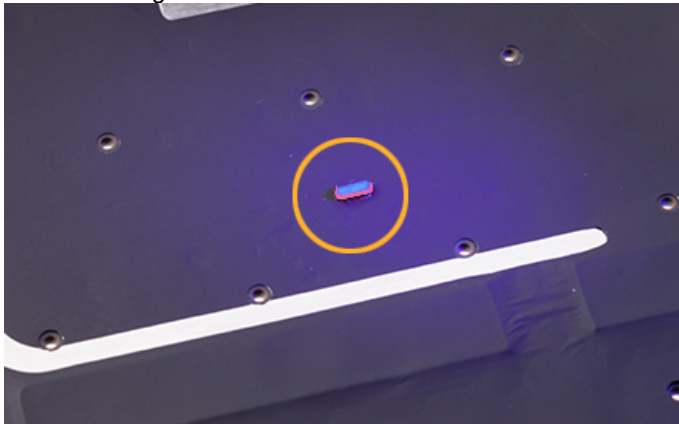


### Liquid Contact:

- LCI without UV light



- LCI with UV light



#### **Safety Information:**

**Caution:** UV LCIs illuminate with the use of the Apple-approved UV light (923-01604). Follow safety precautions when using this tool:

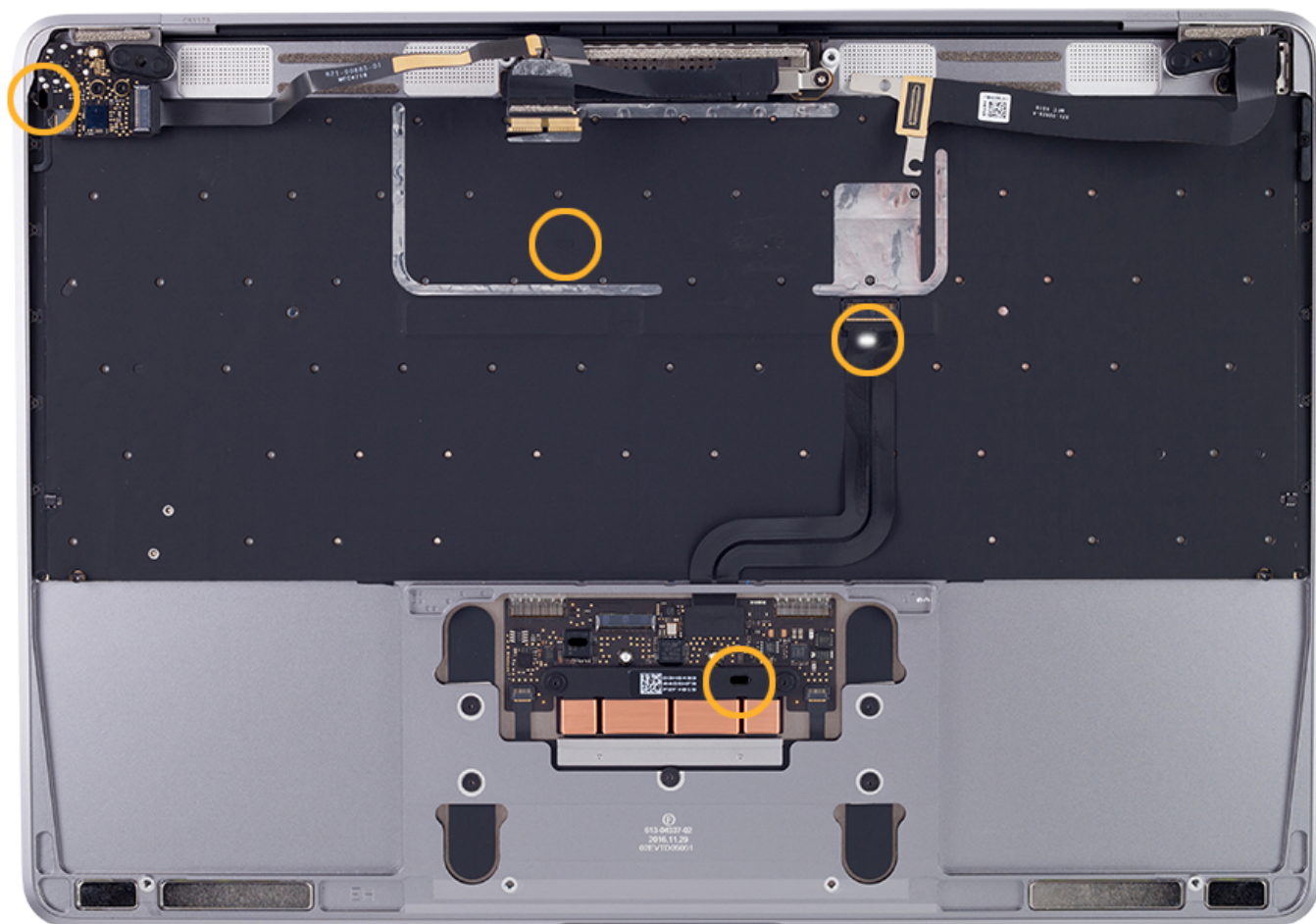
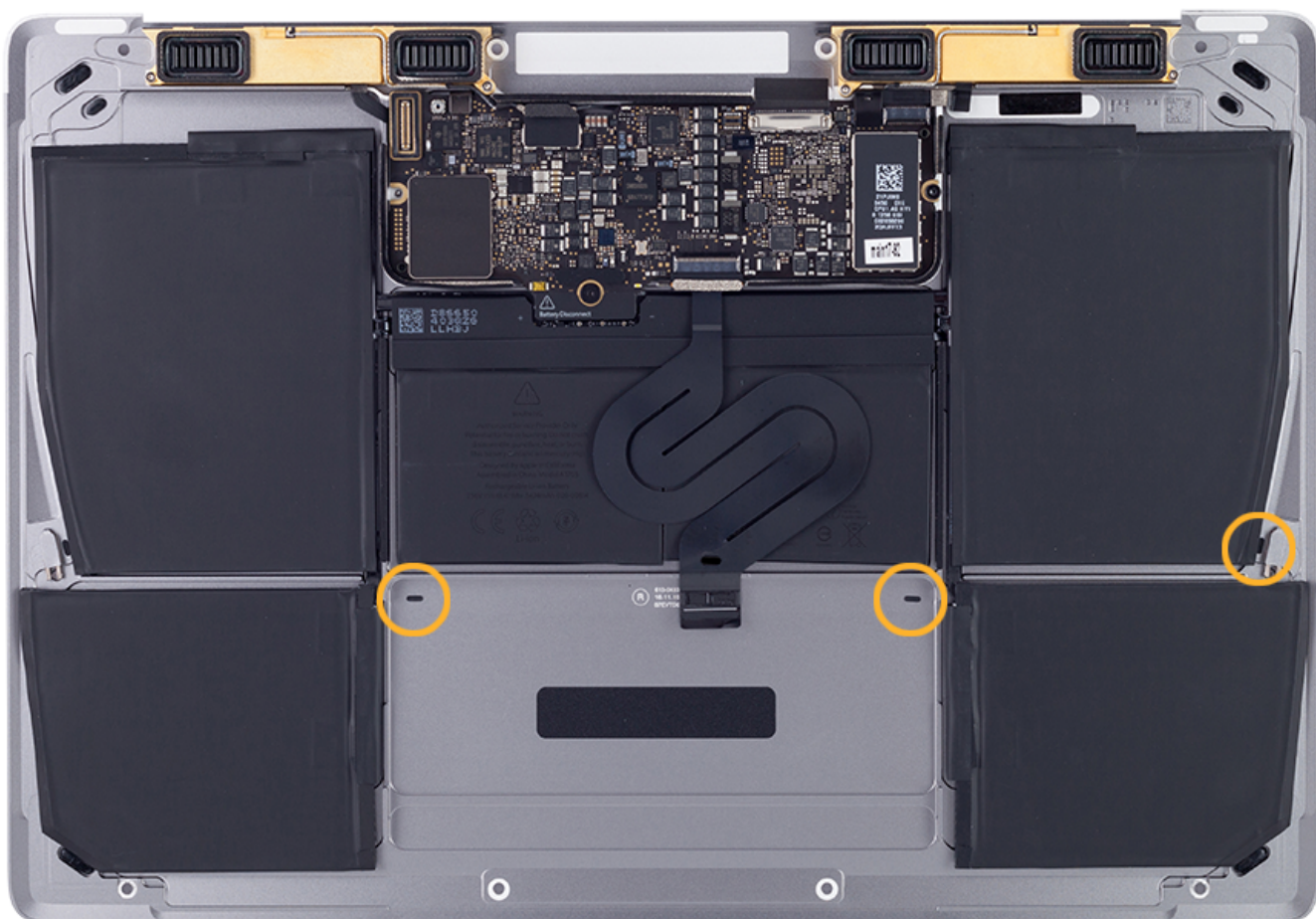
- Do not remove the warning labels on the UV light.



- Do not shine the UV light in anyone's eyes or face.
- Avoid repeated exposure to the UV light.
- If a different UV light is used, safety glasses and gloves must be worn to avoid excessive exposure.

The following images show the general location of LCIs in a MacBook computer.





## Procedure

### Note:

- Ultraviolet LCIs are black. The black LCIs blend in with the rest of the computer. When in contact with liquid, the LCIs may swell and become easier to identify.
- When using the UV light, hold it 12 to 14 inches (30 to 35 centimeters) from the computer and shine it at an angle of 15 to 75 degrees.



**Warning:** While the UV light is shining, do not hold it close to your face or bend your head down to look closely at the LCIs.



1. Press the power button on the UV light.





2. Check the color of the LCI. Blue indicates an LCI that has not been triggered. A pink LCI or a pink halo around the LCI indicates that it has been triggered. Refer to visual examples at the top of this article.

# LCD Pixel Anomalies

When displaying a single color over the screen area, the liquid crystal display (LCD) might show one or more pixels that are not properly lit.

LCD technology uses rows and columns of addressable points (pixels) that render text and images on the screen. Each pixel has three separate subpixels (red, green, and blue) that allow an image to render in full color. Each subpixel has a corresponding transistor responsible for turning the subpixel on and off.

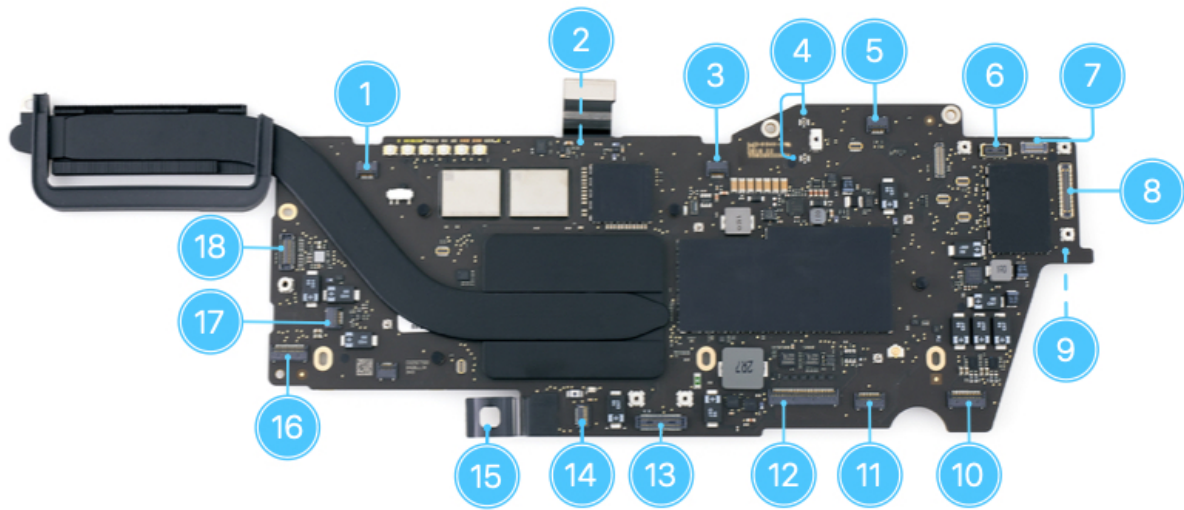
Depending on the display size, there can be thousands or millions of subpixels on an LCD. For example, the LCD used in iMac (27-inch, Late 2013) has a display resolution of 2560 by 1440, which means there are 3.7 million pixels. Each pixel is made up of a red, a green, and a blue subpixel, resulting in over 11 million individual picture elements on the 27-inch display. Occasionally, a transistor may not work perfectly, resulting in the affected subpixel remaining off (dark) or on (bright). With the millions of subpixels on a display, it is possible to have a low number of such transistors on an LCD. In some cases, a small piece of dust or other foreign material may appear to be a pixel anomaly. Apple strives to use the highest-quality LCD displays in its products, but pixel anomalies can occur in a small percentage of them.

In some cases, pixel anomalies are caused by a piece of foreign material that is trapped inside the display or on the surface of the display or glass panel. Foreign material is typically irregular in shape and is usually most noticeable when viewed against a white background.

- For any computer, foreign material on the surface of the display or glass panel can easily be removed using a lint-free cloth.
- For any computer, foreign material trapped inside the display can only be resolved by replacing the entire display assembly.

# MacBook Pro (13-inch, M1, 2020) Functional Overview

Refer to the diagrams for symptoms related to logic board and audio board flex assembly connectors.



## 1 = Keyboard Backlight (Right)

- No keyboard backlight
- Partial keyboard backlight

## 2 = Embedded DisplayPort (eDP) (also carries FaceTime HD camera & Ambient Light Sensor signals)

- No video, blurred, distorted, or monochrome video on display
- No display backlight
- Display does not dim in low light conditions
- Keyboard backlight cannot be enabled
- Camera does not function

## 3 = Keyboard Backlight (Left)

- No keyboard backlight
- Partial keyboard backlight

## 4 = Wi-Fi and Bluetooth Antenna

- No/poor Wi-Fi reception
- Drops Wi-Fi connection
- Does not pair with Bluetooth devices
- Drops Bluetooth connection

## 5 = Microphone

- No microphone audio input (with Internal Microphone selected in Sound Input Preferences)
- Distorted microphone audio input

## 6 = Touch Bar Display

- No video, blurred, distorted, or monochrome video on Touch Bar display

## 7 = Touch Bar Touch

- No touch response on Touch Bar

## 8 = I/O Board

- No power
- No battery charge
- Power adapter issues
- USB connectivity issues
- USB power issues
- No video to external display

- No audio to external display speakers
- Thunderbolt device not found
- Thunderbolt controller not recognized
- Thunderbolt driver issues
- Thunderbolt power issues

#### **9 = Left Hall Effect (Sleep Sensor)**

- No sleep when display closed
- No video to internal display, but video to external display if one is connected (sensor stuck)

#### **10 = Left Speaker**

- No audio from left speaker
- Distorted audio from left speaker

#### **11 = Keyboard Backlight (Power)**

- No keyboard backlight
- Partial keyboard backlight

#### **12 = Keyboard**

- Non-responsive keys

#### **13 = Trackpad**

- No Multi-Touch or cursor movement from built-in trackpad
- No click action from built-in trackpad

#### **14 = Battery Management Unit (BMU) Signal Cable**

- No power
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar

#### **15 = BMU Power and BMU Interconnect Screw**

- No power
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar

#### **16 = Right Speaker**

- No audio from right speaker
- Distorted audio from right speaker

#### **17 = Fan**

- System noise
- Fan not running
- Intermittent shutdown

#### **18 and 19 = Audio Board Flex Assembly (carries signals for audio jack, Touch ID, right Hall effect (sleep) sensor, and power button)**

**Note:** The audio board flex assembly connector on the logic board (18) is shown in the image above, while the audio board flex assembly cable (19) is shown in the image below.

- No sleep when display closed
- No video to internal display, but video to external display if one is connected (sensor stuck)
- No external audio input
- No headphone audio output
- No headset controls or mic input
- Will not turn on from power button
- Will not authenticate using Touch ID





**20 = Right Hall Effect (Sleep Sensor)**

- No sleep when display closed
- No video to internal display, but video to external display if one is connected (sensor stuck)

**21 = Audio Jack**

- No external audio input
- No headphone audio output
- No headset controls or mic input

**22 = Touch ID Board**

- Will not turn on from power button
- Will not authenticate using Touch ID

# Bluetooth or Wi-Fi Issues

## Unlikely causes:

**Likely Causes:** Logic board, vent/antenna module.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Bluetooth service not available.</li><li>• Cannot turn Bluetooth on.</li><li>• Bluetooth can be turned on, but the computer is unable to pair with a known-good Bluetooth device.</li><li>• Intermittent loss of communication with paired Bluetooth device.</li><li>• Data transfer over Bluetooth times out or is too slow.</li></ul> <ul style="list-style-type: none"><li>• Wi-Fi service not available.</li><li>• Cannot turn Wi-Fi on.</li><li>• Wi-Fi can be turned on, but cannot connect to known-good Wi-Fi network.</li><li>• Intermittent loss of Wi-Fi communication.</li><li>• Poor Wi-Fi signal.</li></ul>	<p><b>For Bluetooth issues:</b></p> <ol style="list-style-type: none"><li>1. In System Preferences &gt; Bluetooth, verify that Bluetooth is on.</li><li>2. Attempt to pair the computer with a known-good Bluetooth keyboard, mouse, or trackpad.</li><li>3. Reset the Bluetooth device or delete the pairing (if applicable).</li></ol> <p><b>For Wi-Fi issues:</b></p> <ol style="list-style-type: none"><li>4. In System Preferences &gt; Network, verify that Wi-Fi is on.</li><li>5. Attempt to connect the computer to a known-good Wi-Fi network.</li><li>6. Create a new network location in System Preferences.</li></ol> <p><b>For Bluetooth or Wi-Fi issues:</b></p> <ol style="list-style-type: none"><li>7. If the customer is using a USB device, review <a href="#">HT201163: About USB on Mac computers</a> to identify possible interference with Wi-Fi and Bluetooth communications if the device is positioned near their antennas.</li><li>8. If the user's computer pairs Bluetooth devices correctly or connects to Wi-Fi correctly at your service location, research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to <a href="#">HT201542: Resolve Wi-Fi and Bluetooth issues caused by wireless interference</a>.</li><li>9. Refer to <a href="#">HT202663: If your Mac doesn't connect to the Internet over Wi-Fi</a> to familiarize yourself with the macOS Wireless Diagnostic utility.</li><li>10. <b>Important:</b> Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>. You may need to connect to a wired network to complete all updates</li></ol> <p>If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>11. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Run AST 2 Mac Resource Inspector diagnostic suite (MRI) on the user's computer.</p> <p>Examine diagnostic results to verify that the wireless module is listed.</p> <p>Is wireless module hardware detected?</p>	Yes	Go to step 2.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M99	MLB
2.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Locate the wireless antenna connectors on the logic board. Unplug and inspect the antenna cables and their connectors for any signs of pinched wires or connector damage.</p> <p>Do the antenna cables or connectors show signs of damage?</p>	Yes	<p>Replace the vent/antenna module.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	Go to step 3.	\${nodeText.noSymptomCode}	
3.	<p>With the antenna cables unplugged, inspect the wireless antenna cable connectors on the logic board for housing or pin damage.</p> <p>Do the antenna connectors on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 4.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
4.	<p>Reseat the antenna cable connectors to the logic board, then retest for the Wi-Fi or Bluetooth issue.</p> <p>Is the issue resolved?</p>	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M99	MLB
5.	<p>For Bluetooth, pair with a known-good Bluetooth device and verify that the connection is sustained for several minutes.</p> <p>For Wi-Fi, connect to a known-good wireless network and retest data throughput, checking for adequate transfer speeds.</p> <p>Verify that wireless connection is sustained for several minutes.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Display Functional Issues

## Unlikely causes:

**Likely Causes:** eDP flex cable, display assembly.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Distorted, blurred or illegible image on the display.</li><li>• Inconsistent clarity of image.</li><li>• Pixel anomalies.</li><li>• Vertical or horizontal lines.</li><li>• Vertical lines of nonuniform brightness repeating over the display.</li><li>• Image flickering or intermittent.</li><li>• Video “noise”.</li><li>• Incorrect or missing colors.</li><li>• Non-uniform color, contrast, or brightness.</li><li>• Image persistence or image sticking on screen.</li><li>• Light leakage around the display.</li><li>• Cannot change resolution on display.</li><li>• Display not illuminated.</li><li>• Display backlight not uniform.</li><li>• Display backlight fails after warm-up.</li><li>• Display backlight fails at certain brightness settings.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> This procedure is intended for display issues with the main display only. If the user has display issues with the Touch Bar display (on some models only), return to the list of symptoms and select “Touch Bar Issues”.</p> <ol style="list-style-type: none"><li>1. Thoroughly clean the display surface to remove any dust or debris. Examine the cleaned display and try to reproduce the issue.</li><li>2. Adjust the brightness to the maximum setting.</li><li>3. For issues of display quality, run all relevant display diagnostic suites from AST 2, such as Display Backlight and Color, Display Anomalies, and Image Persistence.</li><li>4. Refer to <a href="#">TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays</a>. If physical damage is found, return to the list of symptoms and select “Mechanical, Physical, Cosmetic, Battery, or Display Damage”.</li><li>5. For issues with pixel anomalies, refer to <a href="#">HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later</a>.</li><li>6. For issues when using closed-display mode, refer to <a href="#">HT201834: Use your Mac notebook computer in closed-display mode with an external display</a>.</li><li>7. <b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>8. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Mac Resource Inspector diagnostic suite (MRI). Review MRI results for information indicating internal display presence.	Yes	Go to step 2.	<code>\$(nodeText.yesSymptomCode)</code>	
		No	Go to step 3.	<code>\$(nodeText.noSymptomCode)</code>	
	Does MRI detect the display?				



	Check	Result	Action	Code	Commodity
2.	<p>While observing the issue, move the display assembly back and forth.</p> <p>Open and close the display fully several times to verify that the cables are not pinched or shorting.</p> <p>Does the symptom change with display movement?</p>	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Go to step 6.	\${nodeText.noSymptomCode}	
3.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the eDP flex cable and its connectors, looking for connector or cable damage.</p> <p>Also check for damage on the display and logic board flex connectors.</p> <p>Did you find damage to this flex cable or any connectors?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	
4.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the eDP flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	<p>Reseat the eDP flex cable connectors on the logic board and display. Reseating the cable can restore normal video.</p> <p>Reassemble the computer and retest the internal display.</p> <p>Is normal video restored?</p>	Yes	<p>The issue was resolved by reseating the eDP flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p> <code>           \${nodeText.yesSymptomCode}         </code> </p>	
		No	Go to step 6.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	
6.	<p>Connect a known-good compatible external display to the user's computer.</p> <p>Check for an image on the connected external display.</p> <p>Is an image clearly visible on the connected external display?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L03	LCD
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M03	MLB

	Check	Result	Action	Code	Commodity
7.	Restart the computer and verify the image on the internal display, backlight, camera, and ambient light sensor are functioning normally.  Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	

# Camera Issues

## Unlikely causes:

**Likely Causes:** eDP flex cable, display assembly.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Camera does not function.</li><li>• No camera indicator light.</li><li>• Excessive blooming in camera image.</li><li>• Poor white balance.</li><li>• Poor focus.</li><li>• Distorted or discolored image.</li><li>• Camera fails to respond to changing ambient light conditions.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Verify camera lens is clear of contaminants.</li><li>2. Ask user about lighting conditions in working environment. Dim lighting causes poor image quality. Overly bright lighting can bounce off surfaces onto subject and make image foggy.</li><li>3. Striped, textured, and mesh clothing can create moiré patterns in image.</li><li>4. Disconnect all peripheral devices and restart computer.</li><li>5. Important: Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>6. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Mac Resource Inspector diagnostic suite (MRI). Review MRI results for information indicating camera presence.	Yes	Go to step 2.	<code>\${nodeText.yesSymptomCode}</code>	
	Does MRI detect camera?	No	Go to step 3.	<code>\${nodeText.noSymptomCode}</code>	
2.	Open Photo Booth. Verify indicator light next to camera lights up. Verify that the image looks normal.	Yes	The issue cannot be duplicated.	<code>\${nodeText.yesSymptomCode}</code>	
	Does camera indicator light up and does image appear normal?	No	Go to step 3.	<code>\${nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
3.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the eDP flex cable and its connectors, looking for connector or cable damage.</p> <p>Also check for damage on the display and logic board flex connectors.</p> <p>Did you find damage to this flex cable or any connectors?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	
4.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the eDP flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
5.	Reseat the eDP flex cable connectors on the logic board and display. Reseating the cable can restore camera functionality.	Yes	<p>The issue was resolved by reseating the eDP flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	\${nodeText.yesSymptomCode}	
	<p>Reassemble the computer and retest for camera functionality.</p> <p>Is camera functionality restored?</p>	No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L17	LCD
6.	Verify that camera now functions as expected and that image quality is normal.	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
	<p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Keyboard Functional Issues

## Unlikely causes:

**Likely Causes:** Top case assembly, keycaps.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Letters or characters repeat unexpectedly.</li><li>• Letters or characters do not appear.</li><li>• One or more keys feel “sticky” or do not respond in a consistent manner.</li><li>• One or more keys feel stuck in down or up position.</li><li>• One or more keys makes abnormal noise when pressed.</li><li>• One or more keys makes a metallic click sound.</li><li>• Key press feels uneven or stiff.</li><li>• Key not responding, spongy, or not going all the way down.</li><li>• Delayed key return.</li><li>• Keycaps or key switch mechanisms broken or missing.</li><li>• Keystrokes are not recognized.</li><li>• Keyboard locks up.</li><li>• Displayed characters do not match the keys pressed.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> Initial keyboard troubleshooting does not involve opening the computer case.</p> <ol style="list-style-type: none"><li>1. Press Caps Lock key to see if LED lights up, indicating at least a partial connection to logic board. Be aware that pressing the Caps Lock key on Apple keyboards may not immediately activate the Caps Lock function. The key must be held down slightly longer in order to activate the Caps Lock function. This is to prevent accidental activation of Caps Lock mode. This is normal behavior and does not indicate a service issue.</li><li>2. In System Preferences &gt; Keyboard &gt; Input Sources, enable Show Input menu in menu bar. From Input menu in the menu bar, select Show Keyboard Viewer. Check if keystrokes on keyboard are recognized in Keyboard Viewer. If built-in keyboard is not functioning, use an external USB keyboard to perform this step.</li><li>3. Confirm that correct keyboard layout is selected in System Preferences &gt; Keyboard &gt; Input Sources. Ensure that any keyboard accessibility features have been disabled by checking System Preferences &gt; Accessibility &gt; General and System Preferences &gt; Accessibility &gt; Keyboard.</li><li>4. Open System Preferences &gt; Accessibility &gt; Mouse &amp; Trackpad. Verify that Mouse Keys is Off. With Mouse Keys on you can use the keyboard or the numeric keypad keys to move the mouse, however normal keyboard functionality will be disabled until the Mouse Keys feature is turned off. Refer to <a href="#">HT203162: One or more keys on the keyboard do not respond</a> for more information.</li><li>5. If a Bluetooth keyboard is present and paired with the unit, it may be overriding input commands from the built-in keyboard. Turn off Bluetooth temporarily to isolate the issue to the built-in keyboard.</li><li>6. <b>Important:</b> Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>7. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Check the keyboard and keycaps for damage by referring to <a href="#">TP1151: Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents</a> .  Are there any damaged keycaps?	Yes	Go to step 2.	\${nodeText.yesSymptomCode}	
		No	Go to step 4.	\${nodeText.noSymptomCode}	
2.	Refer to <a href="#">TP1816: Keycap Replacement</a> . This procedure describes how to remove the affected keycaps. The procedure also lists all keycap kit part numbers for this model.  <b>Important:</b> Before removing any keycaps, verify that the correct keycap kit is available. Any removed keycaps must be replaced by new keycaps. Do not reuse keycaps.  If the correct keycap kit is not available, reply 'NO' to order the keycap kit.  Is the correct keycap kit available?	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Order the correct keycap kit for this model.  Return to this procedure when the kit is available.	K27	PIECE PART

	Check	Result	Action	Code	Commodity
3.	<p>1. Refer to <a href="#">TP1816: Keycap Replacement</a> to remove and replace the affected keycap. A keycap should always be replaced each time it is removed, even for inspection or cleaning.</p> <p>While the keycap is removed, perform the following steps:</p> <p>A. Clean the inner aluminum part of the keycap well to remove any liquid residue that may be present.</p> <p>B. Inspect the scissor mechanism to verify it is functional and has no damaged pins or any other damage. Scissors can also be replaced if damaged.</p> <p>C. Inspect the rubber dome for damage. Keycaps and scissor mechanisms can be replaced, but the rubber dome cannot. A damaged rubber dome requires replacement of the entire top case.</p> <p>2. Refer to <a href="#">TP1816: Keycap Replacement</a> to replace the keycap or replace the scissor mechanism if damaged. Do not reuse keycaps.</p> <p>3. Retest the keyboard to verify that all keyboard keys function normally, and the affected keycap or keycaps no longer exhibit this specific symptom.</p>	Yes	Issue resolved by replacing keycaps.	<code>\${nodeText.yesSymptomCode}</code>	KEYBOARD
	Did this resolve the issue?	No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K27	
4.	<p>A liquid spill can short key signals and stop keyboard operations. Visual inspection indicating liquid spills should be very obvious to you and to user.</p> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered, and if applicable, discuss out-of-warranty repair options. Refer to <a href="#">OP14: Determining and quoting accidental damage for Mac portables</a>.</p> <p>Is it obvious that keyboard keys were exposed to a liquid spill?</p>	Yes	Go to step 5.	<code>\${nodeText.yesSymptomCode}</code>	
		No	Go to step 6.	<code>\${nodeText.noSymptomCode}</code>	



	Check	Result	Action	Code	Commodity
5.	<p>Determine whether liquid damage is limited to the top case or whether multiple parts are damaged.</p> <p>Is there liquid damage to multiple parts?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or for a multipart repair related to liquid spill observation found during repair.</p>	\${nodeText.yesSymptomCode}	
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K90	KEYBOARD
6.	<p>Run the AST 2 Keyboard diagnostic suite to verify that all keys are functional, including modifier keys.</p> <p><b>Note:</b> Diagnostics only verify keyboard electrical operation. Diagnostics do not verify keyboard mechanical feel and response.</p> <p>If you have verified a mechanical issue with the user's keyboard and diagnostic tests pass, reply "Yes."</p> <p>Does the keyboard pass testing?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	Go to step 10.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	<p>Refer to <a href="#">HT205662: How to clean the keyboard of your MacBook or MacBook Pro</a> to carefully apply compressed air to clean the keyboard.</p> <p>Use compressed air and spray around the affected key, in the space between the top case and the keycap.</p> <p>Retest the keyboard to verify that all keyboard keys function normally, and the affected keycap or keycaps no longer exhibit this specific symptom.</p> <p>Did this resolve the issue?</p>	Yes	Issue resolved by cleaning.	\${nodeText.yesSymptomCode}	
		No	Go to step 8.	\${nodeText.noSymptomCode}	
8.	<p>Refer to <a href="#">TP1816: Keycap Replacement</a>. This procedure describes how to remove the affected keycaps. The procedure also lists all keycap kit part numbers for this model.</p> <p><b>Important:</b> Before removing any keycaps, verify that the correct keycap kit is available. Any removed keycaps must be replaced by new keycaps. Do not reuse keycaps.</p> <p>If the correct keycap kit is not available, reply 'NO' to order the keycap kit.</p> <p>Is the correct keycap kit available?</p>	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
		No	<p>Order the correct keycap kit for this model.</p> <p>Return to this procedure when the kit is available.</p>	K99	PIECE PART

	Check	Result	Action	Code	Commodity
9.	1. If cleaning the keyboard did not resolve the issue, then refer to <a href="#">TP1816: Keycap Replacement</a> to remove and replace the affected keycap. A keycap should always be replaced each time it is removed, even for inspection or cleaning.	Yes	Issue resolved by cleaning.	<code>\${nodeText.yesSymptomCode}</code>	
	<p>While the keycap is removed, perform the following steps:</p> <p>A. Clean the inner aluminum part of the keycap well to remove any liquid residue that may be present.</p> <p>B. Inspect the scissor mechanism to verify it is functional and has no damaged pins or any other damage. Scissors can also be replaced if damaged.</p> <p>C. Inspect the rubber dome for damage. Keycaps and scissor mechanisms can be replaced, but the rubber dome cannot. A damaged rubber dome requires replacement of the entire top case.</p> <p>2. Refer to <a href="#">TP1816: Keycap Replacement</a> to replace the keycap or replace the scissor mechanism if damaged. Do not reuse keycaps.</p> <p>3. Retest the keyboard to verify that all keyboard keys function normally, and the affected keycap or keycaps no longer exhibit this specific symptom.</p>	No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K99	KEYBOARD
Did this resolve the issue?					
10.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 12.	<code>\${nodeText.yesSymptomCode}</code>	
	Locate the keyboard or IPD flex cable connector (depending on model) on logic board and verify that this flex cable is present and connected.	No	Go to step 11.	<code>\${nodeText.noSymptomCode}</code>	
Is this flex cable present?					

	Check	Result	Action	Code	Commodity
11.	If keyboard or IPD flex cable is missing, it may be under logic board. Remove logic board to locate the flex cable.	Yes	Issue resolved by reseating keyboard or IPD flex cable.	\${nodeText.yesSymptomCode}	
	Reseat cable firmly to logic board. Reassemble computer.	No	Go to step 12.	\${nodeText.noSymptomCode}	
	Run the AST 2 Keyboard diagnostic suite to verify that all keys are functional after repair, including modifier keys.				
	Is keyboard now functioning?				
12.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
	Disconnect and inspect the keyboard or IPD flex cable and its connectors, looking for connector or cable damage.	No	Go to step 13.	\${nodeText.noSymptomCode}	
	Also check for damage on the trackpad, keyboard, and logic board flex connectors.				
	Did you find damage to this flex cable or any connectors?				
13.	With flex cable reseated to logic board connector, reassemble computer.  Run the AST 2 Keyboard diagnostic suite to verify that all keys are functional after repair, including modifier keys.  Is keyboard now functioning?	Yes	Issue resolved by reseating keyboard or IPD flex cable.	\${nodeText.yesSymptomCode}	
		No	Replace the top case assembly.	K11	KEYBOARD
			Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.		



	Check	Result	Action	Code	Commodity
14.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is there damage to multiple parts?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.yesSymptomCode}	
		No	<p>Replace the keyboard flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
15.	<p>Restart the computer and verify that the keyboard is functioning normally.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Keyboard Backlight Issues

## Unlikely causes:

**Likely Causes:** Top case assembly.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>Keyboard operation is normal except for backlight.</li><li>Keyboard backlight is not detected in a darkened room.</li><li>Keyboard backlight is uneven: some keys are dim or one or more keys are brighter than the other.</li><li>Part of keyboard is not backlit.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> This procedure is intended for backlight issues with the keyboard only. If the user has backlight issues with the Touch Bar display (on some models only), return to the list of symptoms and select “Touch Bar Issues”.</p> <ol style="list-style-type: none"><li>Check System Preferences &gt; Keyboard to see whether the “Adjust keyboard brightness in low light” option is available and checked. Refer to <a href="#">HT202310: Adjust the brightness of your backlit keyboard</a>.</li><li>The keyboard backlight is enabled only when the ambient light sensor (ALS) detects low light conditions. Check System Preferences &gt; Displays to see whether the “Automatically adjust brightness” option is selected.</li><li>Check ALS functionality by covering the sensor (located on the display assembly near the camera) with your hand to simulate a dark room. Check whether the keyboard backlight brightness increases.</li><li>Keep the ALS covered and use controls to increase the keyboard backlight level.</li><li><b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	In AST 2, run the Keyboard test suite and verify that the keyboard backlight illuminates at the appropriate part of the test.	Yes	The issue cannot be duplicated.	<code>#{nodeText.yesSymptomCode}</code>	
	Does the keyboard backlight pass testing?	No	Go to step 2.	<code>#{nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
2.	Keyboard backlight flex cables connect from the top case to the logic board. Each cable drives part of the keyboard backlight (left or right side), and on some models, power to both sides is supplied by a third cable.  Follow Service Guide procedures to locate all keyboard backlight flex cable connectors on the logic board and verify all cables are present and connected.  Are all flex cables present?	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	If a keyboard backlight flex cable is missing, it may be under logic board. Remove logic board to locate keyboard backlight flex cable.  Reseat cable firmly to logic board. Reassemble computer. Adjust keyboard backlight using controls. Cover ALS to activate keyboard backlight in a well lit area.  Is keyboard backlight functioning?	Yes	Issue resolved by reseating keyboard backlight flex cable. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	Disconnect and inspect all keyboard backlight flex cables and their connectors on the logic board.  Check for damage on the flex cables and the logic board connectors.  Is there damage to any keyboard backlight flex cable or any connectors?	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 5.	`\${nodeText.noSymptomCode}`	
5.	With all keyboard backlight flex cables reseated to logic board connectors, reassemble computer.  Retest in low light conditions to activate keyboard backlight. Adjust keyboard backlight using controls.  Is keyboard backlight functioning?	Yes	Issue resolved by reseating keyboard backlight flex cables. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	Replace the top case assembly.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	K10	KEYBOARD

	Check	Result	Action	Code	Commodity
6.	<p>Determine whether damage is limited to any keyboard backlight flex cable (part of the top case), or whether multiple parts are damaged.</p> <p>Is there damage to multiple parts?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.yesSymptomCode}	
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
7.	<p>Restart the computer and verify that the keyboard backlight is functioning normally.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Microphone Issues

## Unlikely causes:

**Likely Causes:** Audio board, top case assembly.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Microphone not working, but audio output is functional.</li><li>• Microphone audio is garbled.</li><li>• Internal microphone input cannot be selected.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Go to System Preferences &gt; Sound, and verify the following:  Input tab:<ul style="list-style-type: none"><li>• Internal Microphone is available and selected for sound input.</li><li>• “Input volume” slider is not set to zero.</li></ul> Output tab:<ul style="list-style-type: none"><li>• Internal Speakers is available and selected for sound output.</li><li>• “Output volume” is not muted or set to zero.</li></ul></li><li>2. Go to System Preferences &gt; Sound &gt; Input tab, and verify that the “Input level” indicator moves when speaking into the microphone.</li><li>3. Check that no cables are inserted into the headphone jack. Use an otoscope to visually inspect jack. Use compressed air to clean and remove any debris.</li><li>4. Disconnect all peripheral devices and restart computer.</li><li>5. <b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>. If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</li><li>6. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Audio Test suite to verify that built-in microphone detects expected audio test patterns produced from each speaker.	Yes	The issue cannot be duplicated.	<code>#{nodeText.yesSymptomCode}</code>	
	Does the computer pass AST 2 Audio Test suite?	No	Go to step 2.	<code>#{nodeText.noSymptomCode}</code>	



	Check	Result	Action	Code	Commodity
2.	Disconnect any connected headphones or external speakers. Go to System Preferences > Sound > Input tab and verify that Internal Microphone is available and selected for sound input.  Does System Preferences list "External Microphone" instead?	Yes	Go to step 3.	#{nodeText.yesSymptomCode}	
		No	Go to step 4.	#{nodeText.noSymptomCode}	
3.	Debris in, or damage to, the headphone jack can cause the computer to become stuck in External Microphone input mode.  Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack.  Use compressed air to clean and remove any debris.  Is there any damage to the headphone jack?	Yes	Replace the audio board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M24	OTHER BOARD
		No	Go to step 4.	#{nodeText.noSymptomCode}	
4.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.  Disconnect the microphone flex cable from the logic board. Inspect the cable and connectors on the logic board and microphone flex cable for any damage.  Did you find damage to this flex cable or any connectors?	Yes	Go to step 5.	#{nodeText.yesSymptomCode}	
		No	Go to step 6.	#{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Microphone and its flex cable are part of top case assembly.</p> <p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	
6.	<p>Reconnect the microphone flex cable to the logic board, verifying that the connectors are all seated properly.</p> <p>Retest by going to System Preferences &gt; Sound &gt; Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Is the internal microphone recognized and functional?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	<p>Microphone and its flex cable are part of top case assembly.</p> <p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K36	KEYBOARD

	Check	Result	Action	Code	Commodity
7.	Run AST 2 Audio Test suite to verify that built-in microphone detects expected audio test patterns produced from each speaker.	Yes	<p>The issue was resolved by cleaning the audio jack or reseating the microphone flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.yesSymptomCode}`	
	Does the computer pass AST 2 Audio Test suite?	No	<p>Microphone and its flex cable are part of top case assembly.</p> <p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K36	KEYBOARD
8.	Verify that the internal microphone is available, selected, and functional, and that the input level indicator moves when speaking into the microphone. Then record a sample audio file and play it back to verify that it is free of distortion.	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
	<p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	`\${nodeText.noSymptomCode}`	

# Power Button or Touch ID Issues

## Unlikely causes:

**Likely Causes:** Touch ID board.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Power button does not click properly or at all.</li><li>• Power button has stiff or spongy feel when pressed.</li><li>• Touch ID is unable to read user's fingerprint.</li><li>• Unable to enroll a user's finger in Touch ID.</li><li>• Unable to unlock computer using Touch ID.</li><li>• Unable to a make purchase using Apple Pay and Touch ID.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Restart the user's computer. After starting up, the user's computer will first prompt for a passcode, not a fingerprint, even if Touch ID is enabled. This is normal behavior. The only time the computer will authenticate using Touch ID is when waking from sleep, not when starting up.</li><li>2. On the computer, have the user go to System Preferences &gt; Touch ID to verify that user has enrolled at least one fingerprint. If no fingerprint is enrolled, Touch ID will be unable to function as expected.</li><li>3. Also in System Preferences &gt; Touch ID, verify that the box next to Unlocking your Mac is checked. If it is not, then Touch ID will not unlock the computer. Verify that the box next to iTunes &amp; App Store is checked. If it is not, then Touch ID cannot be used to make purchases in the iTunes Store, App Store, and iBooks Store. Refer to <a href="#">HT207054: Use Touch ID on your Mac</a> for more information about these settings.</li><li>4. Ensure that the customer's finger and the Touch ID sensor are clean. Check for dirt, debris, oils, lotions, or signs of damage. If necessary, clean the Touch ID sensor and the area surrounding it on the user's computer using a clean microfiber cloth.</li><li>5. Check for cases or protective films. Remove them if they are obstructing the Touch ID sensor or the area surrounding it and then retest for Touch ID functionality.</li><li>6. Have the user try to enroll another fingerprint on the same computer.</li><li>7. Remember that the user's finger needs to move slightly during enrollment. Also, ensure that the user waits for the computer's prompt before lifting a finger.</li><li>8. If user's finger does not reliably work on their computer, try enrolling the user's fingerprint on another known-good computer.</li><li>9. Enroll your own finger with the user's computer and retest for Touch ID functionality. Remove any non-user fingerprints from the computer when testing is complete so that you do not inadvertently leave your biometric information on a user's computer.</li><li>10. Do not service or replace the computer for issues with a specific finger or fingers. If the user has an issue with certain fingers, explain that in some cases Touch ID may be unable to match those fingers consistently. This is usually caused by the readability of that fingerprint, and the user can either try enrolling the fingerprint at a later time, or use a different finger for Touch ID.</li></ol> <p>If you and the user are unable to enroll any fingerprints on the computer, there is an issue with the Touch ID sensor and the computer should be serviced.</p> <ol style="list-style-type: none"><li>11. <b>Important:</b> Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to</li></ol>

	<p><a href="#">HT201541: How to update the software on your Mac.</a></p> <p>If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</p> <p>12. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</p>
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## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Identify the type of issue:	A	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	<p>A. Touch ID issues such as:</p> <ul style="list-style-type: none"> <li>Unable to read user's fingerprint</li> <li>Unable to enroll a user's fingerprint in Touch ID</li> <li>Unable to unlock computer using Touch ID</li> <li>Unable to make a purchase using Apple Pay and Touch ID</li> </ul> <p>B. Power button issues such as:</p> <ul style="list-style-type: none"> <li>Power button does not click properly or at all</li> <li>Power button has a stiff or spongy feel when pressed</li> </ul> <p>Which issue is identified?</p>	B	Go to step 8.	`\${nodeText.noSymptomCode}`	
2.	Run AST 2 Touch ID diagnostic suite on user's computer.	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	<p>Check diagnostic results to verify the functionality of Touch ID hardware.</p> <p>If AST 2 is not available, repeat Quick Check steps to verify Touch ID functionality.</p> <p>Does the computer pass all tests?</p>	No	Go to step 4.	`\${nodeText.noSymptomCode}`	



	Check	Result	Action	Code	Commodity
3.	Repeat Quick Check steps to verify Touch ID functionality.	Yes	Issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Touch ID is not responding as expected if: <ul style="list-style-type: none"> <li>There are authentication errors or failures on the user's computer when attempting to use any finger.</li> <li>Multiple people are having problems enrolling any fingerprint.</li> <li>Registration process cannot begin because the computer cannot detect any finger.</li> </ul>	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
	Is Touch ID responding as expected?				
4.	Isolate the Touch ID issue to one of the following symptoms:	Intermittent Response	Go to step 5.	`\${nodeText.yesSymptomCode}`	
	<ul style="list-style-type: none"> <li>Intermittent response to finger</li> <li>No response to finger</li> </ul>	No Response	Go to step 6.	`\${nodeText.noSymptomCode}`	
	Which issue affects Touch ID?				
5.	Check for and apply the latest software and firmware updates to the user's computer.	Yes	Issue resolved by updating macOS.	`\${nodeText.yesSymptomCode}`	
	Run AST 2 Touch ID diagnostic suite on user's computer to retest Touch ID after software update.	No	Go to step 6.	`\${nodeText.noSymptomCode}`	
	Is the issue resolved after software update?				
6.	Follow Service Guide procedures to gain access to the Touch ID board in the top case.	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
	Disconnect the Touch ID board flex cable from the Audio Board.	No	Replace the Touch ID board.	M46	MPU
	Visually inspect the flex cable and connectors for damage.		Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.		
	Reconnect and reseal the Touch ID board flex cable to the Audio Board.				
	Are you able to reseal this cable?		Verify that the issue is resolved.		

	Check	Result	Action	Code	Commodity
7.	<p>Reassemble the computer.</p> <p>Run AST 2 Touch ID diagnostic suite on user's computer to retest Touch ID after reseating the Touch ID board flex cable.</p> <p>Is the issue resolved after reseating cable?</p>	Yes	Issue resolved by reseating Touch ID board flex cable.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M46	MPU
8.	<p>Inspect the opening on the top case for the power button.</p> <p>Determine whether the opening is misshapen or deformed, preventing proper button operation.</p> <p>Is the opening for the power button damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	Go to step 9.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
9.	Follow Service Guide procedures to remove the bottom case and the logic board to gain access to the Touch ID board in the top case.	Yes	Issue resolved by cleaning Touch ID board area in top case.	\${nodeText.yesSymptomCode}	
	Follow Service Guide procedures to remove the Touch ID board. Inspect the gap between the top case and the Touch ID board for debris.	No	Go to step 10.	\${nodeText.noSymptomCode}	
	If any debris is found that may interfere with power button operation, use compressed air to clean out the debris.				
	Follow Service Guide procedures to reassemble the computer and retest for both power button and Touch ID functionality.				
	Is the issue resolved?				
10.	Troubleshooting this issue completely requires a known-good Touch ID shim kit.  Do you have immediate access to a Touch ID shim kit?	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
		No	Order a Touch ID shim kit.  Return to this procedure when the kit is available.	X03	PIECE PART
11.	A button that feels too loose or too stiff can be caused by installing an incorrect shim that is too large or small.	Yes	Issue resolved by adjusting Touch ID board shim size.	\${nodeText.yesSymptomCode}	
	If the button is not aligned, then follow Service Guide procedures to realign the Touch ID board in the top case.	No	Replace the Touch ID board.	M48	MPU
	If the button feels too loose or has a spongy feel, then try a larger shim.		Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.		
	If the button feels too stiff or does not move, then try a smaller shim.		Verify that the issue is resolved.		
	Reinstall the same Touch ID board using the new shim.				
	Reassemble the computer and retest for both power button and Touch ID functionality.				
	Is the issue resolved?				

	Check	Result	Action	Code	Commodity
12.	Verify that the Touch ID or power button issue is no longer present  Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	

# Touch Bar Issues

## Unlikely causes:

**Likely Causes:** Top case assembly

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Touch Bar image quality issues.</li><li>• Touch Bar touch response issues.</li><li>• Touch Bar functionally issues.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> This procedure is intended for display and touch response issues with the Touch Bar display only. If the user has display issues with the main display, return to the list of symptoms and select “Display Functional Issues”.</p> <ol style="list-style-type: none"><li>1. The Touch Bar backlight should change brightness when the ambient light sensor (ALS) detects low light conditions. Check System Preferences &gt; Displays to see whether the “Automatically adjust brightness” option is selected.</li><li>2. Check ALS functionality by covering the sensor (located on the display assembly near the camera) with your hand to simulate a dark room. Check whether the Touch Bar backlight brightness increases.</li><li>3. <b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>4. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li><li>5. Refer to the following articles for information about the Touch Bar:<ul style="list-style-type: none"><li>• <a href="#">HT207055: How to use the Touch Bar on your MacBook Pro</a></li><li>• <a href="#">HT207240: How to use function keys on MacBook Pro with Touch Bar</a></li><li>• <a href="#">HT207358: How to use the Escape button on the Touch Bar on your MacBook Pro</a></li><li>• <a href="#">HT207258: How to use accessibility features with Touch Bar on your MacBook Pro</a></li></ul></li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run all relevant AST 2 diagnostic suites to verify the presence of the Touch Bar, Touch Bar display, and touch functionality. Examine diagnostic results.	Yes	The issue cannot be duplicated.	<code>#{nodeText.yesSymptomCode}</code>	
		No	Go to step 2.	<code>#{nodeText.noSymptomCode}</code>	
	Does the computer pass all tests?				



	Check	Result	Action	Code	Commodity
2.	Thoroughly clean the Touch Bar surface to remove any dust or debris.	Yes	The issue was resolved by cleaning the Touch Bar. Verify resolution.	\${nodeText.yesSymptomCode}	
	Examine the cleaned Touch Bar and try to reproduce the issue.				
	Is the issue resolved by cleaning the Touch Bar?	No	Go to step 3.	\${nodeText.noSymptomCode}	
3.	Shut down the unit and examine the area of the Touch Bar that is affected by the symptom under a bright light source.	Yes	Replace the top case assembly.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.	K55	KEYBOARD
	Check that the affected area is not damaged by scratches, pits, or damage to the display coating.				
	Refer to <a href="#">TP1151: Visual/Mechanical Inspection (VMI) Guide for Mac - Table of Contents</a> for more information.				
	Does the Touch Bar surface appear damaged?	No	Go to step 4.	\${nodeText.noSymptomCode}	
4.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
	Disconnect and inspect the Touch Bar touch and display flex cables and their connectors, looking for connector or cable damage.	No	Go to step 6.	\${nodeText.noSymptomCode}	
	Also check for damage on the logic board Touch Bar flex connectors.				
	Did you find damage to any flex cable or connectors?				

	Check	Result	Action	Code	Commodity
5.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	
6.	<p>Reconnect the Touch Bar touch and display flex cables to the logic board, verifying that the connections are all seated properly.</p> <p>Reassemble the computer, then run all relevant AST 2 diagnostic suites to verify the presence of the Touch Bar, Touch Bar display, and touch functionality. Examine diagnostic results.</p> <p>Does the computer pass all tests?</p>	Yes	The issue was resolved by reseating the Touch Bar flex cables. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K99	KEYBOARD

	Check	Result	Action	Code	Commodity
7.	Verify that the Touch Bar issue or anomaly is no longer present.  Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	

# Trackpad Issues

## Unlikely causes:

**Likely Causes:** Trackpad.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Cursor does not move with trackpad input.</li><li>• Multi-Touch features are inoperable.</li><li>• Trackpad does not respond to clicks.</li><li>• Trackpad has Haptic feedback issues.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Check for environmental factors such as humidity, hand lotion, or jewelry. Check to see whether the user is touching the trackpad simultaneously with both hands.</li><li>2. With the computer off, clean the trackpad surface using a clean, dry, lint-free cloth.</li><li>3. In System Preferences &gt; Accessibility/Universal Access, disable all assisted “Keyboard” and “Mouse &amp; Trackpad” settings. Retest trackpad functionality.</li><li>4. In System Preferences &gt; Trackpad, check and adjust Click pressure and Trackpad speed. Too-high or too-low settings may be perceived as trackpad issues.</li><li>5. Disconnect all Bluetooth devices. In System Preferences &gt; Bluetooth, click the ‘X’ button next to every device.</li><li>6. <b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>7. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Trackpad diagnostic suite.	Yes	Go to step 5.	<code>\${nodeText.yesSymptomCode}</code>	
	The diagnostic is Multi-Touch capable and will instruct you to touch every part of the trackpad surface to verify its Multi-Touch functionality.	No	Go to step 2.	<code>\${nodeText.noSymptomCode}</code>	
	Does the computer pass Trackpad diagnostic suite?				

	Check	Result	Action	Code	Commodity
2.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the trackpad or IPD flex cable and its connectors, looking for connector or cable damage.</p> <p>Also check for damage on the trackpad, keyboard, and logic board keyboard or IPD flex connectors.</p> <p>Did you find damage to this flex cable or any connectors?</p>	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Go to step 4.	\${nodeText.noSymptomCode}	
3.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the trackpad flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
4.	<p>Carefully reinstall and reseal the trackpad or IPD flex cable.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Does computer pass Trackpad Diagnostic?</p>	Yes	<p>Issue resolved by reseating trackpad flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p>{nodeText.yesSymptomCode}</p>	
		No	Go to step 5.	<p>{nodeText.noSymptomCode}</p>	
5.	<p>Instead of a standard button, this trackpad uses a force sensor to sense clicks, and a linear actuator to simulate the feeling of a click.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of these components, as well as to recalibrate them if necessary.</p> <p>Refer to <a href="#">TP1314: Trackpad Calibration Check</a> for instructions.</p> <p>Important: The calibration check is a very sensitive diagnostic. It requires the use of 200 g and 800 g weights, and must be run on a very stable, flat, and undisturbed work surface. Disruptions to the work surface or misplacement of the weights may cause failures or incorrectly calibrate the trackpad.</p> <p>If the computer fails diagnostic on the first try, it is a good idea to run the diagnostic again after verifying proper weight placement, and that there is no disturbance to the work surface.</p> <p>Does the computer pass Trackpad Calibration Check?</p>	Yes	Go to step 6.	<p>{nodeText.yesSymptomCode}</p>	
		No	<p>Replace the trackpad.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p>K99</p>	MOUSE

	Check	Result	Action	Code	Commodity
6.	<p>After running Trackpad Calibration Check, verify the functionality of the trackpad, since recalibration may have occurred.</p> <p>Is the trackpad functioning properly?</p>	Yes	Issue resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>If you suspect a problem even though the computer passed all trackpad diagnostics, contact CSS for additional support.</p>	\${nodeText.noSymptomCode}	
7.	<p>Check trackpad functionality, including Multi-Touch, click, secondary click, and Force click.</p> <p>For full verification, run the following AST 2 diagnostics suites:</p> <ul style="list-style-type: none"> <li>Trackpad (Multi-Touch surface test)</li> <li>Trackpad Calibration Check</li> </ul> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Speaker or Headphone Jack Issues

**Unlikely causes:**

**Likely Causes:** Audio board, speaker set.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>No sound from headphone jack.</li><li>No sound from left or right speakers.</li><li>Sound is distorted, fuzzy, or crackly.</li><li>Symptom only occurs with internal speakers.</li><li>Symptom only occurs with external speakers or headphones.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>Refer to <a href="#">HT203186: If the internal speakers on your Mac aren't working</a>.</li><li>Go to System Preferences &gt; Sound, and verify the following:  Input tab:<ul style="list-style-type: none"><li>Internal Microphone is available and selected for sound input.</li><li>“Input volume” slider is not set to zero.</li></ul> Output tab:<ul style="list-style-type: none"><li>Internal Speakers is available and selected for sound output.</li><li>“Output volume” is not muted or set to zero.</li></ul></li><li>Go to System Preferences &gt; Sound &gt; Input tab, and verify that the “Input level” indicator moves when speaking into the microphone.</li><li>Check that no cables are inserted into the headphone jack. Use an otoscope to visually inspect jack. Use compressed air to clean and remove any debris.</li><li>Disconnect all peripheral devices and restart computer.</li><li>Important: Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.	Yes	The issue cannot be duplicated.	<code>\$(nodeText.yesSymptomCode)</code>	
	Does the computer pass AST 2 Audio Test suite?	No	Go to step 2.	<code>\$(nodeText.noSymptomCode)</code>	

	Check	Result	Action	Code	Commodity
2.	Disconnect any connected headphones or external speakers. Go to System Preferences > Sound > Output tab and verify that Internal Speaker is available and selected for sound output.  Does System Preferences list “Headphones” instead?	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
3.	Debris in, or damage to, the headphone jack can cause the computer to become stuck in Headphone or External Speaker mode.  Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack.  Use compressed air to clean and remove any debris.  Is there any damage to the headphone jack?	Yes	Replace the audio board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M24	OTHER BOARD
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.  Disconnect the audio board flex cable. Inspect the cable and connectors on the audio board flex cable for any damage.  Did you find damage to this flex cable or any connectors?	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
5.	Determine whether the damage is located on the flex cable, or other parts.  Is the damage limited to the flex cable?	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
6.	<p>Some notebook models have a replaceable audio board flex cable and some models require replacement of the audio board. Refer to the Service Guide for more information.</p> <p>Is the audio board flex cable replaceable in this model?</p>	Yes	<p>Replace the audio board flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p>Replace the audio board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD
7.	Reconnect the audio board flex cable, verifying that the connectors are all seated properly.	Yes	Go to step 8.	\${nodeText.yesSymptomCode}	
	<p>Test the audio output from internal speakers.</p> <p>Can you hear audio through the internal speakers?</p>	No	Go to step 10.	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
8.	<p>Connect known-good headphones or external speakers to test the output from the headphone jack. Verify you can hear audio.</p> <p>Can you hear audio through the headphones or external speakers?</p>	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the audio board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD
9.	<p>Run AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Does the computer pass AST 2 Audio Test suite?</p>	Yes	<p>The issue was resolved by cleaning the headphone jack or reseating the audio board flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.yesSymptomCode}`	
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Locate speaker connections on logic board. Disconnect and inspect both speaker cable connectors and corresponding connectors on logic board for damage.</p> <p>Reconnect the left and right speakers to the logic board, verifying that the connections are all seated properly.</p> <p>Did you find damage to speakers or logic board connector?</p>	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 12.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
11.	<p>Determine whether damage is on the logic board, speakers, or both.</p> <p>Is the damage limited to speakers?</p>	Yes	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	
12.	<p>With speaker connectors reseated to logic board, verify that you can hear audio through internal speakers.</p> <p>In System Preferences &gt; Sound &gt; Output tab, adjust Balance slider to check left and right speaker channel separation.</p> <p>Play music with high and low tones to check bass and tweeter performance of left and right speakers.</p> <p>Do internal speakers present full range of expected audio performance, without distortion?</p>	Yes	<p>The issue was resolved by reseating cables. Verify resolution.</p>	\${nodeText.yesSymptomCode}	
		No	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X08	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
13.	Connect and disconnect headphones or external speakers. Verify that audio can be played through both external and internal speakers, and that sound is clear and free of distortion.  Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	

# USB-C and Thunderbolt Issues

## Unlikely causes:

**Likely Causes:** I/O board, top case assembly.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>USB-C devices are not recognized or not powered when connected to computer's USB-C ports.</li><li>External Thunderbolt devices or displays are not recognized when connected to computer's USB-C ports.</li><li>External HDMI display is not recognized when connected to computer's USB-C ports, using an adapter.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>Verify that the user is not exceeding the specified maximum number of supported external USB-C devices or displays for this model. Two external displays are supported.</li><li>Refer to <a href="#">HT201163: About USB on Mac computers</a>.</li><li>Important: Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>. If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</li><li>Also check for adapter firmware updates by leaving the user's adapter connected to the computer while running software update. If an update is available, update the adapter's firmware before proceeding further, and retest for USB-C connectivity issues.</li><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li><li>Refer to the following articles to learn more about Thunderbolt connectivity in this computer:<ul style="list-style-type: none"><li><a href="#">HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac or iPad Pro</a></li></ul></li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.	Yes	Go to step 2.	<code>#{nodeText.yesSymptomCode}</code>	
	<b>Important:</b> Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.	No	Go to step 3.	<code>#{nodeText.noSymptomCode}</code>	
	Is any USB-C port damaged?				

	Check	Result	Action	Code	Commodity
2.	<p>Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD

	Check	Result	Action	Code	Commodity
3.	<p>Connect the user's computer to a known-good Apple USB-C power adapter with a known-good Apple USB-C charging cable that is the correct type for the user's computer.</p> <p>Connect the power adapter to a known-good electrical outlet.</p> <p>Check that the computer recognizes the power adapter.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information &gt; Power &gt; AC Charger Information that the computer recognizes the power adapter.</p> <p>Test both orientations of the connector.</p> <p>Repeat for all USB-C ports.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	Yes	Go to step 5.	#{nodeText.yesSymptomCode}	
		No	Go to step 4.	#{nodeText.noSymptomCode}	
4.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect then reconnect the I/O board that is related to the affected USB-C port to reseat the connection to the logic board. Reassemble the computer.</p> <p>Connect the user's computer to a known-good power adapter and charging cable that is connected to a known-good electrical outlet.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information &gt; Power &gt; AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	Yes	Go to step 5.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M21	OTHER BOARD



	Check	Result	Action	Code	Commodity
5.	<p>Connect a known-good USB-C device, such as an external disk, to the USB-C port on the computer.</p> <p>Verify in System Information &gt; USB that the device is detected.</p> <p>Test both orientations of the connector.</p> <p>Repeat for all USB-C ports.</p> <p>Is the USB-C device detected?</p>	Yes	Go to step 6.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M37	OTHER BOARD
6.	<p>Connect a known-good Thunderbolt device such as an external disk to the same USB-C port on the computer.</p> <p>Verify in System Information &gt; Thunderbolt that the device is detected.</p> <p>Test both orientations of the connector.</p> <p>Repeat for all USB-C ports.</p> <p>Is the Thunderbolt device detected?</p>	Yes	Go to step 7.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M15	OTHER BOARD

	Check	Result	Action	Code	Commodity
7.	Connect a known-good external Thunderbolt or HDMI display to the user's computer (using a compatible adapter).	Yes	The issue is isolated to the user's USB-C or Thunderbolt peripheral or adapter.	`\${nodeText.yesSymptomCode}`	
	<p>If the display is equipped with internal speakers, also verify audio output.</p> <p>On the user's computer, in System Preferences &gt; Sound &gt; Output, select the external display for sound output.</p> <p>On the display, verify that the correct input has been selected.</p> <p>Verify that a good image appears on the external display.</p> <p>Test the audio output using more than one application or website.</p> <p>Test both orientations of the connector.</p> <p>Repeat for all USB-C ports.</p> <p>Do all test perform as expected?</p>	No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M37	OTHER BOARD
8.	Confirm that known-good USB and Thunderbolt devices are functional and recognized when connected to all USB-C ports on the computer, in both orientations.	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
	<p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	`\${nodeText.noSymptomCode}`	

# Computer Feels Unusually Warm or has Unusual Odors

## Unlikely causes:

**Likely Causes:** Battery, fan, IPD flex cable, logic board, top case assembly, trackpad.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Computer feels unusually warm.</li><li>• Computer or power adapter emits a burning, smoky, or other unusual odor.</li><li>• Excessive fan noise.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Disconnect all peripheral devices and restart computer.</li><li>2. Verify the temperature issue with the computer resting on a hard, flat surface. <b>Note:</b> Use this opportunity to educate the user about inappropriate work surfaces that may cause the computer to overheat. Refer to article <a href="#">HT201640: Keep your Mac notebook within acceptable operating temperatures</a>.</li><li>3. Compare the computer's operating temperature to a known-good, similarly configured computer.</li><li>4. Be aware that new computers will run hotter and louder during initial setup and Spotlight indexing. This is normal behavior and is not considered a service issue.</li><li>5. Check for runaway applications using the information in <a href="#">HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity</a>. Follow the instructions to halt any processes that are using excessive system resources.</li><li>6. Processor-intensive or graphics-intensive applications and system processes may cause the bottom case to feel warm. Use Activity Monitor to identify these types of applications and explain the issue to the user.</li><li>7. <b>Important:</b> Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>8. Inspect the enclosure and components for obvious signs of burning or smoky residue. Check the rear vents, keyboard, slots, and ports, as well as the power adapter, USB-C connector, and charging cable.</li><li>9. Clean the enclosure to eliminate any causes due to external contamination.</li><li>10. Verify that the vents allow unobstructed airflow into and out of the computer.</li><li>11. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Determine whether this is a safety issue.</p> <p>Do not perform procedures that can be a safety risk to you or the user.</p> <p>Have you identified a safety issue?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for safety-related issues. Refer to article <a href="#">OP44: Handling Potential Product Safety Issues</a>.</p> <p>Retail: Document the issue and escalate following the steps in <a href="#">RS60: Product Safety Escalations</a>.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 2.		
2.	<p>Determine if the computer is unusually warm or has unusual odors:</p> <p>A. Unusually warm</p> <p>B. Unusual odors</p> <p>Which issue is identified?</p>	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Go to step 19.		
3.	<p>While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the computer.</p> <p>MRI will report a failure if any sensors are not detected or are exceeding expected thermal values.</p> <p>Does the computer pass all MRI tests?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.		
4.	<p>Run AST 2 Cooling System Diagnostic (CSD) diagnostics suite.</p> <p>CSD works like a stress test on the computer, gathering information about the thermal performance while various components are under heavy use.</p> <p>Does the computer pass all CSD tests?</p>	Yes	<p>The computer passed all thermal checks and is operating within specifications. Verify correct operation and refer the customer to <a href="#">HT201640: Keep your Mac notebook within acceptable operating temperatures</a>.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 5.		

	Check	Result	Action	Code	Commodity
5.	<p>A disconnected or malfunctioning fan will prevent proper cooling and may cause thermal sensors to exceed expected values. An obstructed fan or heat sink may also cause excessive fan noise.</p> <p>Check diagnostic results for fan motor failures.</p> <p><b>Note:</b> Some computer models do not have a fan. Reply 'NO' to skip this question and continue troubleshooting for models without a fan.</p> <p>Did diagnostics report any fan motor test failure?</p>	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
		No	Go to step 10.	\${nodeText.noSymptomCode}	
6.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the fan flex cable and its connectors, looking for connector or cable damage.</p> <p>Also check for damage on the logic board fan flex connectors.</p> <p>Did you find damage to this flex cable or any connectors?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	Go to step 8.	\${nodeText.noSymptomCode}	
7.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the trackpad flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	Carefully reseal the fan flex cable into its connector.	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
	Reassemble the computer and run diagnostics again.  Do diagnostics still report a fan failure?	No	Issue resolved by reseating fan flex cable. Verify resolution.	\${nodeText.noSymptomCode}	
9.	Remove the fan to reveal inner side of heat sink. Use an ESD-safe vacuum to remove dust and debris from heat sink and fan.  Reassemble the computer and run diagnostics again.  Do diagnostics still report a fan failure?	Yes	Replace the fan.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	X22	OTHER ELECTRIC
		No	Issue resolved by cleaning fan and heat sink. Verify resolution.	\${nodeText.noSymptomCode}	
10.	Check diagnostic results for trackpad thermal sensor errors.	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
	Did diagnostics report any trackpad thermal sensor errors?	No	Go to step 15.	\${nodeText.noSymptomCode}	
11.	Run AST 2 Trackpad diagnostic suite.	Yes	Go to step 15.	\${nodeText.yesSymptomCode}	
	The diagnostic is Multi-Touch capable and will instruct you to touch every part of the trackpad surface to verify its Multi-Touch functionality.  Does the computer pass Trackpad diagnostic suite?	No	Go to step 12.	\${nodeText.noSymptomCode}	
12.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 13.	\${nodeText.yesSymptomCode}	
	Disconnect and inspect the trackpad or IPD flex cable and its connectors, looking for connector or cable damage.  Also check for damage on the trackpad, keyboard, and logic board keyboard or IPD flex connectors.  Did you find damage to this flex cable or any connectors?	No	Go to step 14.	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
13.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the trackpad flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
14.	<p>Carefully reinstall and reseal the trackpad or IPD flex cable.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Does computer pass Trackpad Diagnostic?</p>	Yes	<p>Issue resolved by reseating trackpad flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p>{nodeText.yesSymptomCode}</p>	
		No	<p>Replace the trackpad.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p>K85</p>	<p>MOUSE</p>
15.	<p>Check diagnostic results for battery thermal sensor errors.</p> <p>Did diagnostics report any battery thermal sensor errors?</p>	Yes	Go to step 16.	<p>{nodeText.yesSymptomCode}</p>	
		No	Go to step 18.	<p>{nodeText.noSymptomCode}</p>	
16.	<p>While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the battery.</p> <p>Check MRI results for any battery-specific warnings or failures.</p> <p>Does MRI report any battery errors?</p>	Yes	Go to step 17.	<p>{nodeText.yesSymptomCode}</p>	
		No	Go to step 18.	<p>{nodeText.noSymptomCode}</p>	

	Check	Result	Action	Code	Commodity
17.	<p>Some notebook models have a replaceable battery and some models require replacement of the top case assembly. Refer to the Service Guide for more information.</p> <p>Is the battery replaceable in this model?</p>	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	P17	BATTERY
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K85	KEYBOARD
18.	<p>Check diagnostic results for failures related to any other logic board thermal sensor errors</p> <p>Did diagnostics report any logic board thermal sensor errors?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
		No	Go to step 19.	\$_{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
19.	<p>An odor can be related to external contamination. Inspect the computer exterior for contamination or lack of cleanliness.</p> <p>Can you determine that the odor is caused by external contamination?</p>	Yes	Go to step 20.	#{nodeText.yesSymptomCode}	
		No	Go to step 21.	#{nodeText.noSymptomCode}	
20.	<p>Thoroughly clean enclosure and all external surfaces. Refer to <a href="#">HT204172: How to clean your Apple products</a>. Explain the cause to the user.</p> <p>Does user agree that the odor is due to external contamination?</p>	Yes	The issue is resolved. Verify resolution.	#{nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	#{nodeText.noSymptomCode}	
21.	<p>Odors can be related to product newness. Refer to <a href="#">HT202324: Odors may be present short-term</a>.</p> <p>Can you determine that the odor is due to the product being new?</p>	Yes	Go to step 22.	#{nodeText.yesSymptomCode}	
		No	Go to step 23.	#{nodeText.noSymptomCode}	
22.	<p>Explain to the user that new computers can sometimes emit an odor, similar to odors generated from new carpeting or a new car. In most cases, the odor dissipates after a brief period.</p> <p>Does the user agree that the odor is related to the computer being new?</p>	Yes	The issue is resolved. Verify resolution.	#{nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	#{nodeText.noSymptomCode}	
23.	<p>Closely inspect internal components and the enclosure for indications of physical or liquid damage or contamination.</p> <p>Refer to <a href="#">TP1150: Visual/Mechanical Inspection (VMI) Guide for Mac Liquid Damage</a> for guidance regarding possible liquid damage to the user's computer.</p> <p>Can you identify signs of internal damage or contamination?</p>	Yes	Go to "Mechanical, Physical, or Cosmetic Damage".	#{nodeText.yesSymptomCode}	
		No	Go to step 24.	#{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
24.	<p>Closely inspect internal hardware and the enclosure for other possible causes of odor, such as bulging or vented chip capacitors, or visible residue or burn marks on the enclosure, logic board, or other components.</p> <p>Have you identified a component failure as the source of the odor?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.yesSymptomCode}	
		No	The issue cannot be duplicated.	\${nodeText.noSymptomCode}	
25.	<p>Use Cooling System Diagnostic to verify that the computer is running within thermal specifications.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Mechanical, Physical, Cosmetic, Battery, or Display Damage

## Unlikely causes:

There are no unlikely causes for this issue.

## Quick Check

Symptoms	Quick Check
<p>The computer shows signs of physical or cosmetic damage such as:</p> <ul style="list-style-type: none"><li>• Enclosure and Battery:<ul style="list-style-type: none"><li>• Loose or broken hinges.</li><li>• Stripped, loose, or missing screw.</li><li>• Liquid spill.</li><li>• One or more battery cells have increased in size.</li><li>• Computer wobbles and will not sit evenly on flat surface.</li><li>• Bottom case cannot be reinstalled.</li></ul></li><li>• Display Assembly:<ul style="list-style-type: none"><li>• Cracked or broken display frame or assembly housing, or cracked display glass.</li><li>• Scratches.</li><li>• Dents.</li><li>• Liquid spill.</li></ul></li><li>• Keyboard and Top Case:<ul style="list-style-type: none"><li>• Worn paint on one or more keys on the built-in keyboard.</li><li>• Scratches.</li><li>• Dents.</li><li>• Liquid spill.</li></ul></li><li>• AC Power Adapter:<ul style="list-style-type: none"><li>• Mechanical damage to adapter connector, cable, or housing.</li><li>• Scratches.</li><li>• Dents.</li><li>• Liquid spill.</li></ul></li></ul> <p><b>Note:</b> Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to <a href="#">OP14: Determining and quoting accidental damage for Mac portables</a>.</p>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Inspect the computer and discuss the nature of the issue with the user. Determine whether the user wants to proceed with the repair (despite possible accidental damage) or pursue other service options. Click “No” to proceed with further troubleshooting.</li><li>2. Refer to <a href="#">TP1151: Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents</a> for guidance regarding possible damage to the user's computer.</li><li>3. Check for correct installation of bottom case. An expanded battery may be preventing complete installation of the bottom case cover.</li><li>4. Refer to <a href="#">OP14: Determining and quoting accidental damage for Mac portables</a> to check for causes that would prevent correct installation of the bottom case or battery.</li><li>5. Refer to <a href="#">HT204762: Enclosure separation due to expanded or swollen battery</a>.</li><li>6. Follow the guidelines in <a href="#">OP693: Embedded battery visual inspection</a>.</li><li>7. Follow the guidelines in <a href="#">OP24: Safely handling lithium batteries and lithium battery-powered devices</a>.</li><li>8. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine whether issue involves a safety risk.	Yes	<b>ESCALATION REQUIRED.</b>	\${nodeText.yesSymptomCode}	
	Do not perform procedures that can be a safety risk to you or the user.		Contact CSS for safety-related issues. Refer to <a href="#">OP44: Handling Potential Product Safety Issues</a> .		
	Have you identified a safety issue?	No	Retail: Document the issue and escalate following the steps in <a href="#">RS60: Product Safety Escalations</a> . Go to step 2.	\${nodeText.noSymptomCode}	



	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	<p>Inspect the battery for any sign of battery cell puncture, leakage, venting, or cell deformation.</p> <p>Refer to section five of <a href="#">OP24: Safely handling lithium batteries and lithium battery-powered devices</a>, titled “Venting batteries.”</p> <p>Recognize battery cell electrolyte leakage.</p> <p>Apply a protective battery cover to the computer battery that is being serviced.</p>				
2.	<p><b>If a battery cell is leaking:</b></p> <ol style="list-style-type: none"> <li>1. Keep all personnel at a safe distance to prevent persons from coming in contact with spilled material.</li> <li>2. Eliminate all ignition sources and other debris (no heat sources, sparks, or flames in immediate area).</li> </ol> <p>A leaking battery should only be handled by trained and properly equipped personnel.</p> <p>Are any battery cells punctured, leaking, or deformed?</p>	No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
3.	Inspect the top case assembly for any physical damage.	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.yesSymptomCode}	
	Replacement of multiple parts requires an escalation to CSS for repair approval.				
	Does the top case require replacement?	No	Go to step 6.	\${nodeText.noSymptomCode}	
4.	Check the battery and bottom case installation. Verify that the battery has not expanded to deform the enclosure or separate the bottom case and top case.	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
	One or more battery cells might have expanded, resulting in pressure on the bottom case cover.  Refer to <a href="#">OP693: Embedded battery visual inspection</a> .  Place a protective battery cover on the computer being serviced.  Has one or more battery cells expanded in size?	No	Go to step 7.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	Inspect the bottom case for deformation due to battery swelling.	Yes	<b>ESCALATION REQUIRED.</b>	`\${nodeText.yesSymptomCode}`	
	Check that the bottom case can be installed correctly on new top case.		Contact CSS for additional support or a multipart repair.		
	Replacement of multiple parts requires an escalation to CSS for repair approval.	No	Go to step 6.	`\${nodeText.noSymptomCode}`	
	Does the bottom case require replacement?				
6.	Some notebook models have a replaceable battery and some models require replacement of the top case assembly. Refer to the Service Guide for more information.	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	P13	BATTERY
	Is the battery replaceable in this model?	No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K33	KEYBOARD
7.	Closely examine the user's computer for signs of enclosure damage as described in symptoms.	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	X12	ENCLOSURE
	Does the computer exhibit this type of damage?	No	Go to step 8.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
8.	Closely examine the user's computer enclosure for signs of liquid spill damage.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	X90	ENCLOSURE
	Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's enclosure.				
	Does the computer exhibit this type of damage?	No	Go to step 9.	`\${nodeText.noSymptomCode}`	
9.	Closely examine the user's computer for signs of display assembly damage, such as a cracked or broken display frame or assembly housing, or cracked display glass.	Yes	Refer to <a href="#">TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays</a> for specific instructions and criteria regarding cracked displays.  Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	L99	LCD
	Does the computer exhibit this type of damage?				
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	Closely examine the user's computer display assembly for signs of cosmetic damage, such as:	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	L19	LCD
	<ul style="list-style-type: none"> <li>Scratches</li> <li>Dents</li> </ul>				
	Does the computer exhibit this type of damage?	No	Go to step 11.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
11.	Closely examine the user's computer display assembly for signs of liquid spill damage.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	L90	LCD
	Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's display assembly.				
	Does the computer exhibit this type of damage?	No	Go to step 12.	\${nodeText.noSymptomCode}	
12.	Closely examine the user's computer keyboard and top case for signs of cosmetic damage such as:	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	K21	KEYBOARD
	<ul style="list-style-type: none"> <li>Scratches</li> <li>Dents</li> </ul>				
	Does the computer exhibit this type of damage?	No	Go to step 13.	\${nodeText.noSymptomCode}	
13.	Closely examine the user's computer keyboard and top case for signs of cosmetic damage such as:	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	K35	KEYBOARD
	<ul style="list-style-type: none"> <li>Paint is wearing off of one or more keys on the built-in keyboard.</li> </ul>				
	Does the computer exhibit this type of damage?	No	Go to step 14.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
14.	Closely examine the user's computer keyboard and top case for signs of liquid spill damage.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	K90	KEYBOARD
	Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's keyboard and top case.  Does the computer exhibit this type of damage?	No	Go to step 15.	`\${nodeText.noSymptomCode}`	
15.	Closely examine the user's AC power adapter for signs of connector damage such as: <ul style="list-style-type: none"> <li>• Pins stuck, broken, burnt, pushed in, or bent.</li> </ul>	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="https://www.apple.com/legal/warranty">https://www.apple.com/legal/warranty</a> for details.	P15	ADAPTER
	Does the AC power adapter exhibit this type of damage?	No	Go to step 16.	`\${nodeText.noSymptomCode}`	
16.	Closely examine the user's AC power adapter for signs of mechanical damage such as: <ul style="list-style-type: none"> <li>• Adapter connector or cable</li> <li>• Adapter housing</li> </ul>	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	P16	ADAPTER
	Does the AC power adapter exhibit this type of damage?	No	Go to step 17.	`\${nodeText.noSymptomCode}`	



	Check	Result	Action	Code	Commodity
17.	Closely examine the user's AC power adapter for signs of cosmetic damage such as: <ul style="list-style-type: none"> <li>Scratches</li> <li>Dents</li> </ul>	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	P21	ADAPTER
	Does the AC power adapter exhibit this type of damage?	No	Go to step 18.	\${nodeText.noSymptomCode}	
18.	Closely examine the user's AC power adapter for signs of liquid spill damage.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	P90	ADAPTER
	Look for any signs of liquid spill, liquid penetration, or liquid damage to the user's AC power adapter.	No	Go to step 19.	\${nodeText.noSymptomCode}	
19.	Closely examine the user's USB-C charge cable and connectors for damage.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="https://www.apple.com/legal/warranty">https://www.apple.com/legal/warranty</a> for details.	X03	EXTERNAL CABLE
	Refer to <a href="#">TP1520: Visual/Mechanical Inspection (VMI) Guide for Mac Portables USB-C Cables</a> when inspecting the user's cable.	No	<b>ESCALATION REQUIRED.</b>  Contact CSS for assistance with Apple-related accidental damage.	\${nodeText.noSymptomCode}	
	Does the USB-C charge cable exhibit damage according to the VMI?				

# Noise, Hum, or Vibration

**Unlikely causes:**

**Likely Causes:** Fan, power adapter.

**Quick Check**

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Computer or power adapter emits noise or vibration.</li><li>• Excessive fan noise (some models only).</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> Verify the issue after using the computer for a few minutes to warm it, or by following steps in <a href="#">HT207571: Warm a Mac for testing</a>. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none"><li>1. Work with user to reproduce issue and isolate source of noise. Determine whether source of noise is computer or power adapter.</li><li>2. If power adapter is source of noise, test with a known-good adapter. (A small amount of hum or vibration is normal for power adapters.)</li><li>3. If necessary, explain to user that some noises are normal. Refer to <a href="#">HT202179: About fans and fan noise in your Apple product</a>.</li><li>4. While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the computer. MRI will report a failure if any sensors are not detected or are exceeding expected thermal values. An unreadable thermal sensor can cause a fan to run excessively. If MRI reports any thermal sensor failures, return to the list of symptoms and select "Computer Feels Unusually Warm or has Unusual Odors". Otherwise, continue troubleshooting.</li><li>5. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

**Deep Dive**

	Check	Result	Action	Code	Commodity
1.	Shut down the computer and let it cool off fully. Once the computer is cold, start it up and check for noise, hum, or vibration.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	
	Does issue persist during cold startup?				

	Check	Result	Action	Code	Commodity
2.	<p>A disconnected or malfunctioning fan will prevent proper cooling and may cause thermal sensors to exceed expected values. An obstructed fan or heat sink may also cause excessive fan noise.</p> <p>Check diagnostic results for fan motor failures.</p> <p><b>Note:</b> Some computer models do not have a fan. Reply 'NO' to skip this question and continue troubleshooting for models without a fan.</p> <p>Did diagnostics report any fan motor test failure?</p>	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Go to step 8.	\${nodeText.noSymptomCode}	
3.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the fan flex cable and its connectors, looking for connector or cable damage.</p> <p>Also check for damage on the logic board fan flex connectors.</p> <p>Did you find damage to this flex cable or any connectors?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	
4.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the fan.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X23	OTHER ELECTRIC
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	With fan disconnected, briefly retest for noise, hum, or vibration.  Has noise been eliminated?	Yes	Replace the fan.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	X23	OTHER ELECTRIC
		No	Go to step 6.	\$_{nodeText.noSymptomCode}	
6.	Carefully reseal the fan flex cable into its connector.	Yes	Go to step 7.	\$_{nodeText.yesSymptomCode}	
	Reassemble the computer and run diagnostics again.  Do diagnostics still report a fan failure?	No	Issue resolved by resealing fan flex cable. Verify resolution.	\$_{nodeText.noSymptomCode}	
7.	Remove the fan to reveal inner side of heat sink. Use an ESD-safe vacuum to remove dust and debris from heat sink and fan.  Reassemble the computer and run diagnostics again.  Do diagnostics still report a fan failure?	Yes	Replace the fan.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	X23	OTHER ELECTRIC
		No	Issue resolved by cleaning fan and heat sink. Verify resolution.	\$_{nodeText.noSymptomCode}	
8.	Substitute a known-good compatible power adapter and retest.	Yes	Replace power adapter. Verify that the issue is resolved.	P04	ADAPTER
	Has noise been eliminated?	No	Go to step 9.	\$_{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
9.	Disconnect any peripheral devices, cards, or cables attached to computer.  Has noise been eliminated?	Yes	Issue resolved.  Issue caused by ground loop induced by third-party devices. Advise user to connect all devices to a common power outlet or contact device manufacturer for support.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	Noise may be related to interference from other electrical devices operating near computer or plugged into same power outlet.  See if noise is eliminated when computer runs in a different location on a different circuit.  Has noise been eliminated?	Yes	Issue resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	`\${nodeText.noSymptomCode}`	
11.	Verify that noise, hum, or vibration is resolved.  Use Cooling System Diagnostic to verify that the computer is running within thermal specifications.  Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	`\${nodeText.noSymptomCode}`	

# Battery and Power Adapter Issues

## Unlikely causes:

**Likely Causes:** AC wall adapter (duckhead), battery, I/O board, power adapter, power cord, top case assembly, USB-C charging cable.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• “X” in battery status menu.</li><li>• Battery menu displays messages such as Service Battery, Replace Now, or Replace Soon.</li><li>• Battery not charging.</li><li>• Battery runs out of power very quickly, or without any warning.</li><li>• No lightning bolt icon in battery status menu or power connection feedback when power adapter is connected.</li><li>• The computer does not start up from shutdown when the power adapter is attached.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Verify that applications or other software issues are not forcing the computer to consume battery power. Refer to <a href="#">HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity</a>. To help extend battery performance, refer the user to <a href="#">HT204054: About Mac notebook batteries</a>.</li><li>2. Verify that the user’s power adapter and charging cable are the correct models for the user’s computer. Refer to <a href="#">HT201700: Find the right power adapter and cable for your Mac notebook</a>. Different power adapters and USB-C charging cables may appear similar but may not provide sufficient power to turn on or charge the computer.</li><li>3. Check for damage or debris in the USB-C connectors on the user’s computer, power adapter, AC wall adapter, and charging cable. Refer to <a href="#">TP1125: Visual/Mechanical Inspection (VMI) Guide for Power Adapters for Mac Portables</a> and <a href="#">TP1520: Visual/Mechanical Inspection (VMI) Guide for Mac Portables USB-C Cables</a>.</li><li>4. Connect the power adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user’s computer.</li><li>5. If the battery is drained on the user’s computer, connect it to a known-good power adapter with a known-good charging cable and charge the computer for up to 10 minutes to verify that the computer’s battery can charge. If the user’s computer does not turn on with a known-good power adapter, return to the list of symptoms and select “No Power”.</li><li>6. Run AST 2 Power Adapter diagnostics with the user’s power adapter connected to a known-good computer to confirm that the power adapter is functioning.</li><li>7. Run AST 2 Power Adapter diagnostics with a known-good power adapter connected to the user’s computer to confirm that the computer is functioning.</li><li>8. <b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>9. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li><li>10. Refer to the following articles to learn more about power-related features and functions specific to this computer that may be misinterpreted as service issues:<ul style="list-style-type: none"><li>• <a href="#">HT207097: Charge your MacBook Pro with Thunderbolt</a></li></ul></li></ol>

	<p>3</p> <ul style="list-style-type: none"> <li>• <a href="#">HT201150: How to turn your Mac on or off</a></li> <li>• <a href="#">HT204652: If your USB-C power adapter isn't charging your Mac notebook</a></li> <li>• <a href="#">HT204700: Battery may not charge or drains while using AC power</a></li> <li>• <a href="#">HT211246: If you see 'not charging' when your Mac notebook is connected to power</a></li> <li>• <a href="#">HT211832: About battery health management in Mac notebooks</a></li> <li>• <a href="#">HT201585: Determine battery cycle count for Mac notebooks</a></li> </ul>
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## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.  <b>Important:</b> Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.  Is any USB-C port damaged?	Yes	Go to step 2.	<code>\${nodeText.yesSymptomCode}</code>	
		No	Go to step 3.	<code>\${nodeText.noSymptomCode}</code>	



	Check	Result	Action	Code	Commodity
2.	<p>Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD
3.	<p>Connect the user's computer to a known-good Apple USB-C power adapter with a known-good Apple USB-C charging cable that is the correct type for the user's computer.</p> <p>Connect the power adapter to a known-good electrical outlet.</p> <p>Check that the computer recognizes the power adapter.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information &gt; Power &gt; AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
4.	Shut down the computer.	Yes	Go to step 6.	#{nodeText.yesSymptomCode}	
	<p>Disconnect and flip the orientation of the USB-C charging cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>The computer should turn on automatically.</p> <p>Verify in System Information &gt; Power &gt; AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	No	Go to step 5.	#{nodeText.noSymptomCode}	
5.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	The issue was resolved by reseating the I/O board. Verify resolution.	#{nodeText.yesSymptomCode}	
	<p>Disconnect then reconnect the I/O board to reseat the connection to the logic board and reassemble the computer.</p> <p>Connect the user's computer to a known-good power adapter and charging cable that is connected to a known-good electrical outlet.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information &gt; Power &gt; AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M21	OTHER BOARD
6.	Substitute the user's power adapter and recheck System Information > Power > AC Charger Information to verify that the computer recognizes the user's power adapter.	Yes	Go to step 7.	#{nodeText.yesSymptomCode}	
	<p>Does the computer recognize the user's power adapter?</p>	No	Replace the power adapter. Verify that the issue is resolved.	P23	ADAPTER

	Check	Result	Action	Code	Commodity
7.	Run Power Adapter diagnostics suite.	Yes	Replace the power adapter. Verify that the issue is resolved.	P23	ADAPTER
	Power Adapter diagnostics suite may report a faulty power adapter, which could cause short battery runtimes.	No	Go to step 8.	\${nodeText.noSymptomCode}	
8.	Does Power Adapter diagnostics suite report a power adapter failure?				
	While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the battery.	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
	Check MRI results for any battery-specific warnings or failures.	No	Go to step 10.	\${nodeText.noSymptomCode}	
	Does MRI report any battery errors?				
9.	Some notebook models have a replaceable battery and some models require replacement of the top case assembly. Refer to the Service Guide for more information.	Yes	Replace the battery.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	P09	BATTERY
		No	Replace the top case assembly.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	K41	KEYBOARD
	Is the battery replaceable in this model?				

	Check	Result	Action	Code	Commodity
10.	Substitute the user's charging cable with the known-good power adapter.	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
	Verify that the computer turns on and charges.  Does the computer recognize the user's USB-C charging cable?	No	Replace the USB-C charging cable. Verify that the issue is resolved.	X03	EXTERNAL CABLE
11.	Run AST 2 Power Adapter diagnostic suite on the user's computer with the user's power adapter and charging cable connected to confirm that the user's power adapter and charging cable are both functioning.	Yes	The issue cannot be duplicated.	\${nodeText.yesSymptomCode}	
	Does the computer pass all tests?	No	Go to step 12.	\${nodeText.noSymptomCode}	
12.	Substitute the user's AC wall adapter (duckhead) or power cord for a known-good AC wall adapter or power cord.	Yes	Replace the power cord or AC wall adapter (duckhead). Verify that the issue is resolved.	X03	EXTERNAL CABLE
	Retest with AST 2 Power Adapter diagnostics.  Does the computer pass all tests?	No	Go to step 13.	\${nodeText.noSymptomCode}	
13.	Substitute a known-good, compatible power adapter.	Yes	Replace the power adapter. Verify that the issue is resolved.	P23	ADAPTER
	Retest with AST 2 Power Adapter diagnostics.  Does the computer pass all tests?	No	Replace the USB-C charging cable. Verify that the issue is resolved.	X03	EXTERNAL CABLE
14.	Verify that the battery or power adapter issue is resolved.	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
	Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	

# Intermittent Shutdown, Kernel Panic, or System Instability

## Unlikely causes:

**Likely Causes:** Logic board, battery.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Computer shuts down during startup.</li><li>• Computer shuts down unexpectedly during use.</li><li>• Computer restarts and displays a kernel panic alert message.</li><li>• Computer freezes during use.</li><li>• Computer freezes upon wake from sleep.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> Verify the issue after using the computer for a few minutes to warm it, or by following steps in <a href="#">HT207571: Warm a Mac for testing</a>. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none"><li>1. Collect the following details from the user regarding shutdown occurrence and system configuration: when shutdown occurs (for example, on battery power or after running for a while), the frequency of shutdowns, which applications are running at the time, and shutdown repeatability.</li><li>2. Refer to <a href="#">HT200553: If your Mac restarted because of a problem</a>.</li><li>3. Attempt to start up in Safe Mode to verify that the computer can start up completely without any issues. Refer to <a href="#">HT201262: How to use safe mode on your Mac</a> for more information.</li><li>4. <b>Important:</b> Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.  If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</li><li>5. While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the computer. MRI will report a failure if any sensors are not detected or are exceeding expected thermal values. An unreadable thermal sensor can cause intermittent shutdowns.  Also run Cooling System Diagnostic suite (CSD). CSD works like a stress test on the computer, gathering information about the thermal performance while various components are under heavy use.  If MRI or CSD report any thermal sensor or fan failures, return to the list of symptoms and select "Computer Feels Unusually Warm or has Unusual Odors". Otherwise, continue troubleshooting.</li><li>6. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Power or thermal issues can cause intermittent shutdowns. Run AST 2 Mac Resource Inspector diagnostic suite (MRI) to check for problems detected by sensors and fans.	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
	<p>Identify the specific type of failure reported in MRI: Thermal sensor, fan failure, voltage or current sensor, or some other failure.</p> <p>There are three types of sensors that are used in the computer: voltage, current, and temperature. The sensor type is identified by the first letter in the sensor key.</p> <ul style="list-style-type: none"> <li>Voltage sensor keys start with “V”</li> <li>Current sensor keys start with “I”</li> <li>Temperature sensor keys start with “T”</li> </ul> <p>If MRI reports any thermal sensor or fan failures, return to the list of symptoms and select “Computer Feels Unusually Warm or has Unusual Odors”.</p> <p>Does MRI report any voltage or current sensor errors?</p>	No	Go to step 2.	\${nodeText.noSymptomCode}	
2.	Run AST 2 Power Adapter diagnostic suite on the user’s computer.	Yes	Go to “Battery and Power Adapter Issues”.	\${nodeText.yesSymptomCode}	
	<p>MRI may report a consumed or defective battery. Power Adapter diagnostics may report a faulty power adapter.</p> <p>Either issue can cause intermittent shutdowns.</p> <p>Does MRI or Power Adapter diagnostic suite report a battery or power adapter failure?</p>	No	Go to step 3.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
3.	Run AST 2 Full System Diagnostic suite and check whether the computer unexpectedly shuts down.  Is the shutdown event reproducible?	Yes	Replace the logic board and Touch ID board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M8	MLB
		No	The issue cannot be duplicated.	\${nodeText.noSymptomCode}	
4.	Check diagnostic results for battery current or voltage sensor errors.  Did diagnostics report any battery current or voltage sensor errors?	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	Go to step 6.	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
5.	<p>Some notebook models have a replaceable battery and some models require replacement of the top case assembly. Refer to the Service Guide for more information.</p> <p>Is the battery replaceable in this model?</p>	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	P19	BATTERY
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K41	KEYBOARD

	Check	Result	Action	Code	Commodity
6.	<p>Check diagnostic results for logic board current or voltage sensor errors.</p> <p>Did diagnostics report any logic board current or voltage sensor errors?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M23	MLB
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	
7.	<p>Verify that the computer no longer unexpectedly shuts down or kernel panics.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Startup Issues

## Unlikely causes:

**Likely Causes:** Logic board.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>The computer does not start up completely when it is turned on.</li><li>The computer displays an exclamation point (!) with a circle around it.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>Disconnect all peripherals.</li><li>Determine whether the computer has power by confirming that any of the following function correctly:<ul style="list-style-type: none"><li>Fan spins (some models only).</li><li>Trackpad clicks when pressed.</li><li>Power connection feedback occurs.</li><li>The built-in display functions.</li><li>A connected external display functions.</li></ul></li></ol> <p>If the user's computer shows no signs of power, return to the list of symptoms and select "No Power".</p> <ol style="list-style-type: none"><li>Determine whether the computer is in DFU mode. Press and hold the power button for 10 seconds to attempt to shut down the computer. Then press the power button again to attempt to turn on the computer. If the computer turns on, then it was in DFU mode and has power.</li><li>Refer to <a href="#">HT204267: If your Mac doesn't turn on</a> and <a href="#">HT211873: If your Mac starts up to a dark screen with 'Options'</a>.</li><li>Attempt to start up in Safe Mode to verify that the computer can start up completely without any issues. Refer to <a href="#">HT201262: How to use safe mode on your Mac</a> for more information.</li><li>If the user's Mac cannot start up to macOS and also cannot start up to macOS Recovery, an exclamation point with a circle around it is displayed. If you see this symbol when attempting to start up the user's computer, follow recommended steps in <a href="#">HT204156: If your Mac doesn't start up all the way</a>.</li><li>Refer to <a href="#">HT204463: If the fans in your Mac run at full speed when you turn it on</a>.</li><li>Connect the user's computer to a known-good compatible power adapter with a known-good charging cable and charge the computer for up to 10 minutes to verify that the computer's battery can charge. If the user's computer does not charge with a known-good power adapter, return to the list of symptoms and select the "No Power" troubleshooting flow.</li><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect a known-good compatible external display to the user's computer.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	<p>Connect the user's computer to the user's power adapter and charging cable that is connected to a known-good electrical outlet.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>First check for an image on the built-in display.</p> <p>Is an image visible on the built-in display?</p>	No	Go to "Display Functional Issues".	`\${nodeText.noSymptomCode}`	
2.	Restart the computer and verify that it completes the startup process.	Yes	The issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Does the computer complete the startup process?	No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	Verify that the computer is turned off, then press and hold the power button for 10 seconds. Select macOS Recovery from Startup Options to start up into macOS Recovery. See <a href="#">HT201314: About macOS Recovery</a> .	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
	<p>Verify that the computer starts up to macOS Recovery.</p> <p>Does the computer start up to macOS Recovery?</p>	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	Revive the computer using <a href="#">Apple Configurator 2 User Guide</a> and a host Mac.	Yes	The issue was resolved by reviving the computer. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	<p><b>Important:</b> Always ask if the user's data has been backed up first.</p> <p>Restart the computer and verify that it completes the startup process.</p> <p>Does the computer complete the startup process?</p>	No	Go to step 8.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
5.	Restart the computer and run AST 2 Full System Diagnostic suite on the computer.  Check diagnostic results for any failures.  Does the computer pass all tests?	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	MLB
		No	Replace the logic board and Touch ID board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M02	
6.	Restart the computer to macOS Recovery.  Use Disk Utility to verify the computer's internal startup volume.  If errors are seen, use Disk Utility to repair the computer's internal startup volume.  Restart the computer and verify that it completes the startup process.  Does the computer complete the startup process?	Yes	The issue was resolved by repairing the startup volume using Disk Utility. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
7.	Start up the computer to macOS Recovery.  Use the 'Install macOS' option to update or reinstall macOS.  <b>Important:</b> Always ask if the user's data has been backed up first.  Restart the computer and verify that it completes the startup process.  Does the computer complete the startup process?	Yes	The issue was resolved by updating or reinstalling macOS. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
8.	Restore the computer using using <a href="#">Apple Configurator 2 User Guide</a> and a host Mac.	Yes	The issue was resolved by restoring the computer. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	<b>Important:</b> Always ask if the user's data has been backed up first. The restore process will delete all user data and reinstall a new macOS and macOS Recovery.				
	Restart the computer and verify that it completes the startup process.	No	Go to step 9.	`\${nodeText.noSymptomCode}`	
	Does the computer complete the startup process?				
9.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	`\${nodeText.yesSymptomCode}`	
	Inspect all internal cables and connectors for damage.  Are any internal cables or connectors damaged?	No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.		Yes	The issue was resolved by reseating the internal connections. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	Reseat the internal connections and reassemble the computer.  Restart the computer and verify that it completes the startup process.  Does the computer complete the startup process?	No	Replace the logic board and Touch ID board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M02	MLB

	Check	Result	Action	Code	Commodity
11.	<p>Verify that the computer can now complete the startup process over multiple trials.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	



# No Power

## Unlikely causes:

**Likely Causes:** AC wall adapter (duckhead), battery, I/O board, logic board, power cord, power adapter, top case assembly, USB-C charging cable.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>The computer does not turn on when the display is opened.</li><li>The computer does not turn on when the power button is pressed.</li><li>The computer does not turn on when the power adapter is connected.</li><li>The computer does not turn on when any keyboard key is pressed while the display is open.</li><li>The computer does not turn on when the trackpad is pressed while the display is open.</li><li>No image appears on the built-in display.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>Disconnect all peripherals.</li><li>Determine whether the computer has power by confirming that any of the following function correctly:<ul style="list-style-type: none"><li>Fan spins (some models only).</li><li>Trackpad clicks when pressed.</li><li>Power connection feedback occurs.</li><li>The built-in display functions.</li><li>A connected external display functions.</li></ul></li><li>Determine whether the computer is in DFU mode. Press and hold the power button for 10 seconds to attempt to shut down the computer. Then press the power button again to attempt to turn on the computer. If the computer turns on, then it was in DFU mode and has power.</li><li>Refer to <a href="#">HT204267: If your Mac doesn't turn on</a>.</li><li>Verify that the user's power adapter and charging cable are the correct models for the user's computer. Refer to <a href="#">HT201700: Find the right power adapter and cable for your Mac notebook</a>. Different power adapters and USB-C charging cables may appear similar but may not provide sufficient power to turn on or charge the computer.</li><li>Check for damage or debris in the USB-C connectors on the user's computer, power adapter, AC wall adapter, and charging cable. Refer to <a href="#">TP1125: Visual/Mechanical Inspection (VMI) Guide for Mac Notebook Power Adapters</a> and <a href="#">TP1520: Visual/Mechanical Inspection (VMI) Guide for Mac Notebook USB-C Cables</a>.</li><li>Connect the power adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer.</li><li>Connect the user's computer to a known-good compatible power adapter with a known-good charging cable and charge the computer for up to 10 minutes to verify that the computer's battery can charge.</li><li>Run AST 2 Power Adapter diagnostics with the user's power adapter connected to a known-good computer to confirm that the power adapter is functioning.</li><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect a known-good compatible external display to the user's computer.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	Connect the user's computer to the user's power adapter and charging cable that is connected to a known-good electrical outlet.				
	The computer should turn on automatically if it is off when the power adapter is connected.	No	Go to step 3.	`\${nodeText.noSymptomCode}`	
	First check for an image on the built-in display.				
2.	Is an image clearly visible on the built-in display?				
	Restart the user's computer and verify that it completes the startup process.	Yes	The issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Does the computer complete the startup process?	No	Go to "Startup Issues".	`\${nodeText.noSymptomCode}`	
3.	Next, check for an image on the connected external display.	Yes	Go to "Display Functional Issues".	`\${nodeText.yesSymptomCode}`	
	Is an image clearly visible on the connected external display?	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	Verify that the computer is turned off, then press and hold the power button for 10 seconds. Select macOS Recovery from Startup Options to start up into macOS Recovery. See <a href="#">HT201314: About macOS Recovery</a> .	Yes	The issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Verify that the computer starts up to macOS Recovery.	No	Go to step 5.	`\${nodeText.noSymptomCode}`	
	Does the computer start up to macOS Recovery?				
5.	Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
	<b>Important:</b> Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.	No	Go to step 7.	`\${nodeText.noSymptomCode}`	
	Is any USB-C port damaged?				

	Check	Result	Action	Code	Commodity
6.	<p>Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD
7.	<p>Substitute the user's AC wall adapter (duckhead) or power cord for a known-good AC wall adapter or power cord.</p> <p>Attempt normal startup again.</p>	Yes	<p>Replace the power cord or AC wall adapter (duckhead). Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE
	Does the computer turn on with a known-good AC wall adapter or power cord?	No	Go to step 8.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	
8.	<p>Substitute a known-good, compatible power adapter.</p> <p>Attempt normal startup again.</p>	Yes	<p>Replace the power adapter. Verify that the issue is resolved.</p>	P23	ADAPTER
	Does the computer turn on with a known-good power adapter?	No	Go to step 9.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	
9.	<p>Substitute a known-good, USB-C charging cable that is the correct type for the user's computer.</p> <p>Attempt normal startup again.</p>	Yes	<p>Replace the USB-C charging cable. Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE
	Does the computer turn on with a known-good charging cable?	No	Go to step 10.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	

	Check	Result	Action	Code	Commodity
10.	<p>Unplug the charging cable from the computer.</p> <p>Follow service guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Connect the charging cable to the computer.</p> <p>Attempt normal startup again.</p> <p>Does the computer turn on when the battery is disconnected?</p>	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M01	MLB
11.	<p>Some notebook models have a replaceable battery and some models require replacement of the top case assembly. Refer to the Service Guide for more information.</p> <p>Is the battery replaceable in this model?</p>	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	P19	BATTERY
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K20	KEYBOARD

	Check	Result	Action	Code	Commodity
12.	<p>Verify that the computer can now turn on and complete the startup process over multiple trials.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# MacBook Pro (13-inch, 2019 and 2020, Two Thunderbolt 3 Ports) and MacBook Pro (13-inch, M1, 2020) Connector Types on Logic Board

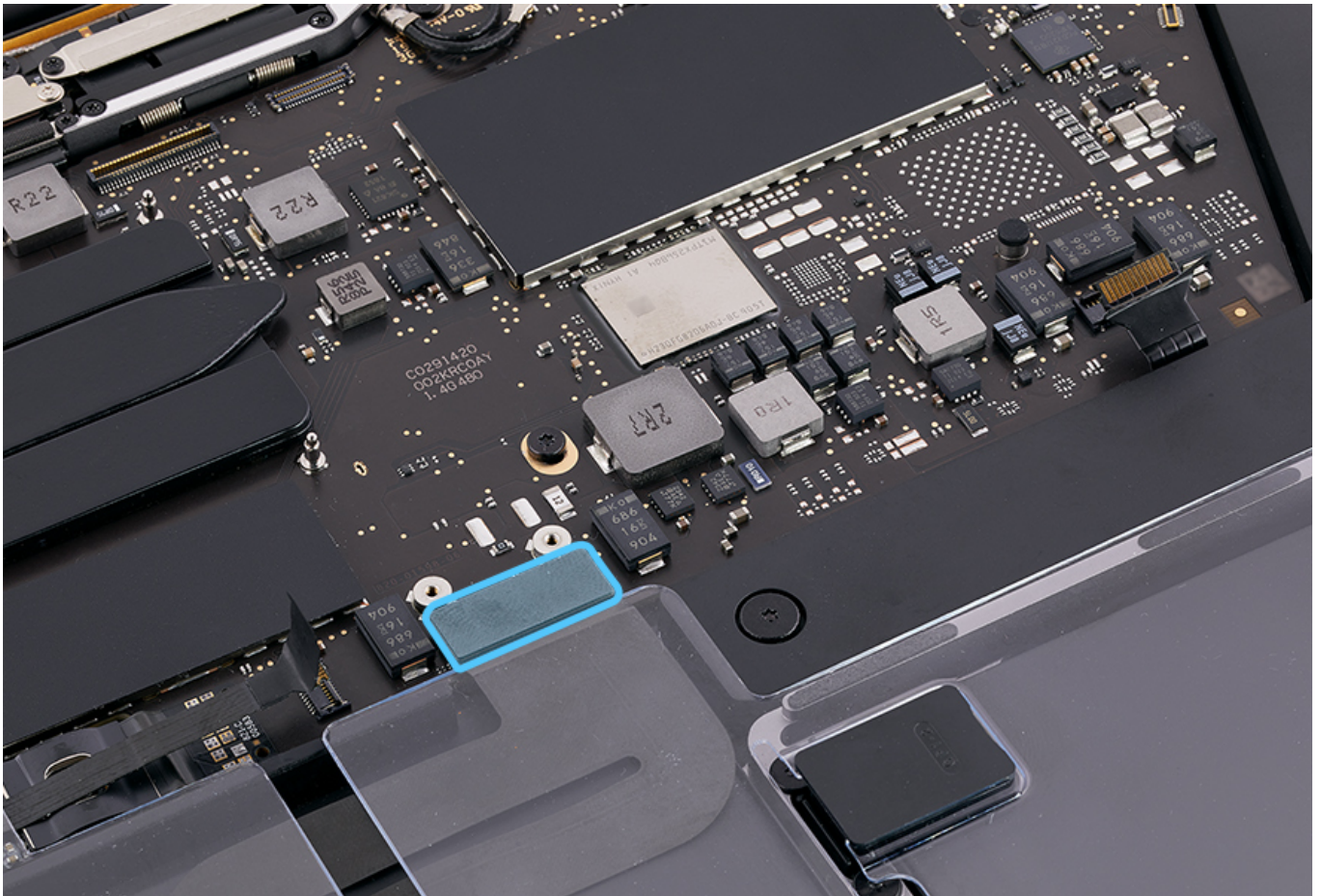
## Connector Types on Logic Board for MacBook Pro (13-inch, 2019 and 2020, Two Thunderbolt 3 Ports) and MacBook Pro (13-inch, M1, 2020)

### Low-Profile Solid Platform

- Disconnect the flex cable from the solid platform connector in one vertical motion. This type of connector is susceptible to bent pins if the flex cable is rocked from side to side or inserted improperly.
- Reconnect the flex cable to the solid platform connector by first aligning the flex cable over the solid platform connector receptacle. Press down evenly on the top of the flex cable connector to insert it into the connector receptacle.

Examples:

- Audio board flex assembly
- Trackpad
- Embedded DisplayPort (eDP)
- I/O Board
- Touch Bar touch and Touch Bar display



### Locking Lever

- Flip up lever 90 degrees and evenly disconnect cable.
- Lock down lever after inserting cable.
- Close lever when handling or shipping a logic board module, whether a known-good or a known-bad board.

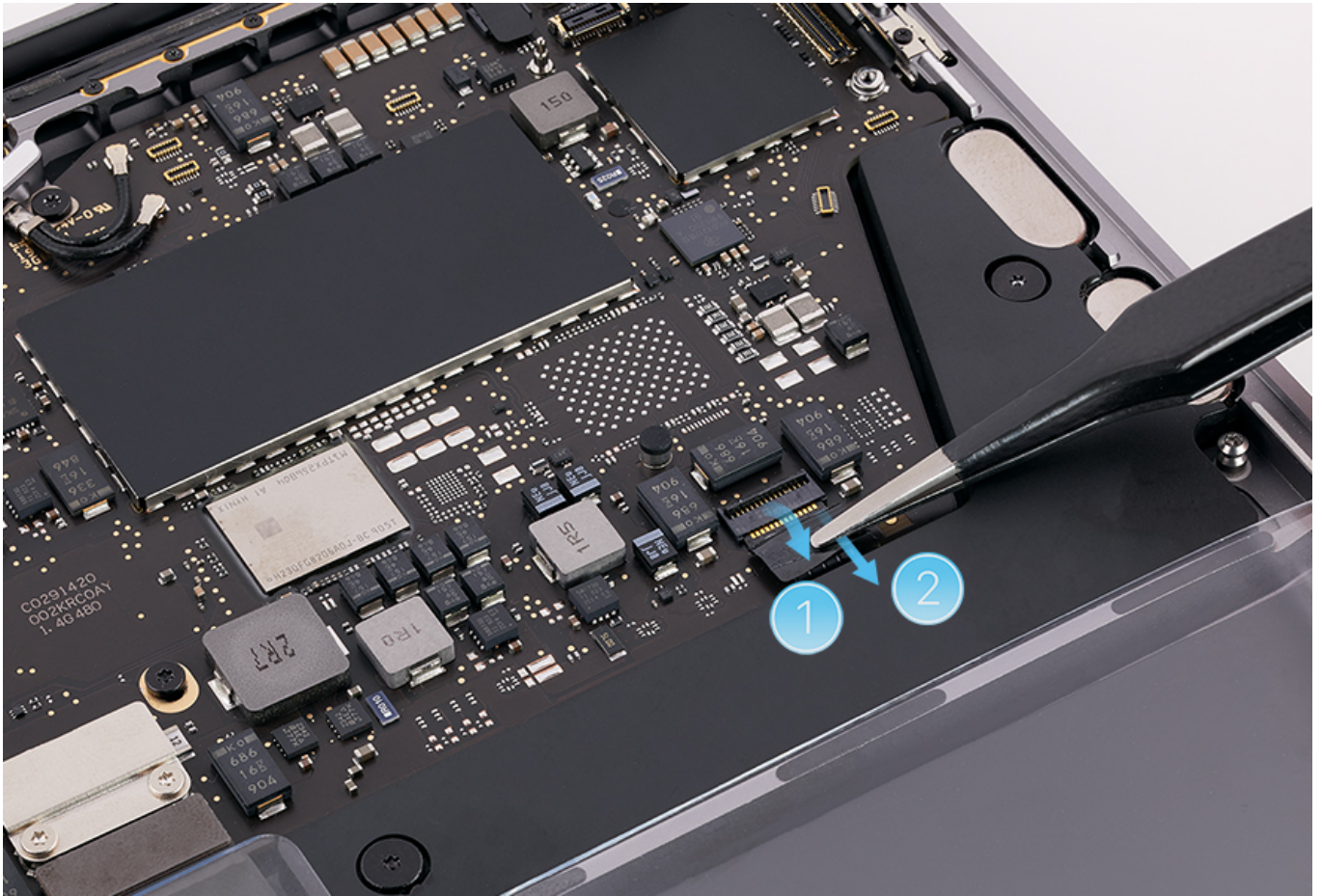
Examples:

- Speaker
- Keyboard
- Fan
- Battery Management Unit (BMU) Signal





**Caution:** The locking levers on the logic board are fragile. To protect the levers during handling or shipment of the logic board, close the levers after the cables are disconnected. Once the logic board is installed in the top case and the cables are connected, be sure to lock down the levers again.



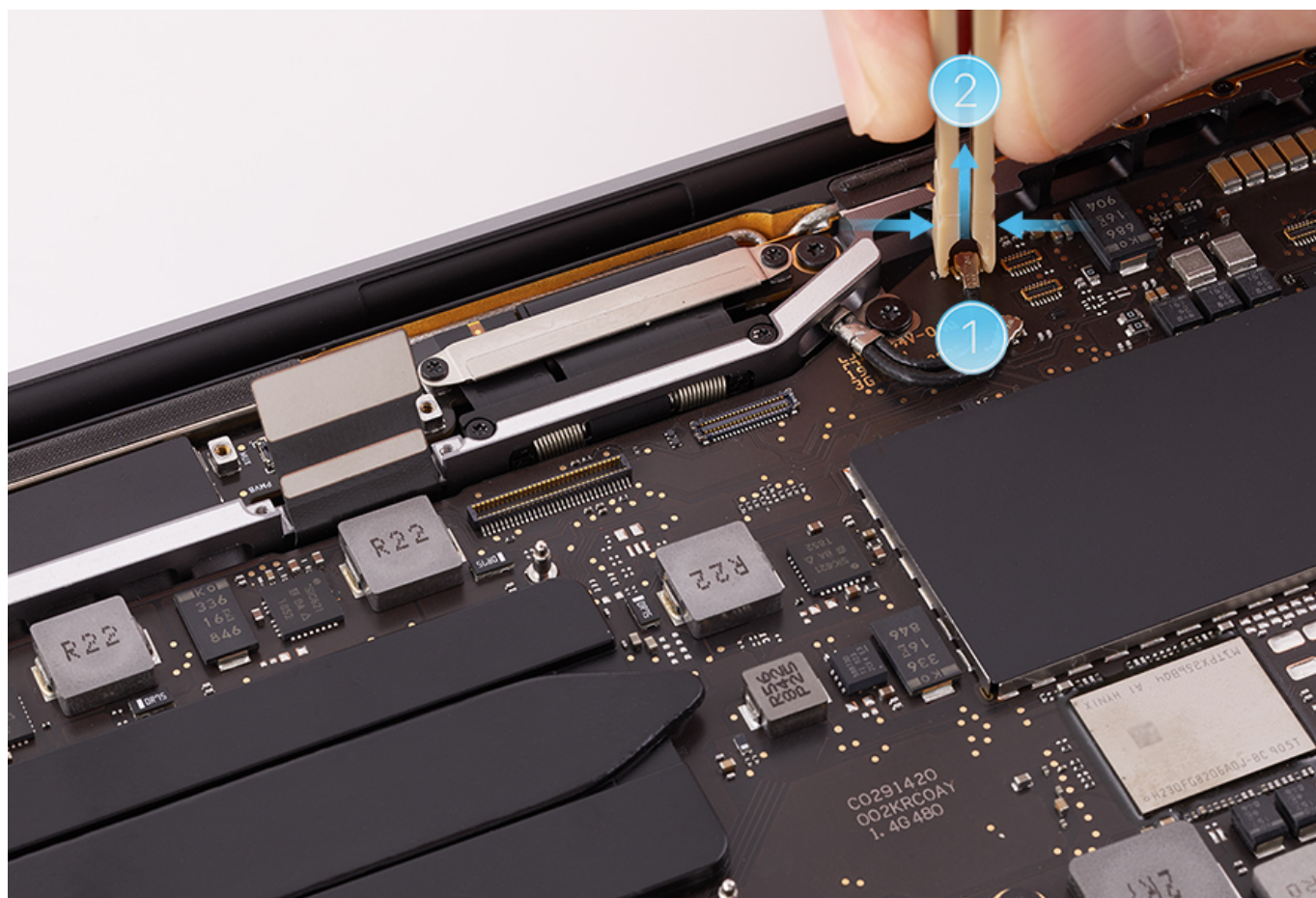
### Wireless Antenna Cables

- With the antenna tool, grasp the head of the cable (1) and gently lift up (2).
- To reconnect line up the coaxial cable over the connector and use the flat side of the antenna tool to connect.

Examples:

- Wi-Fi and Bluetooth antenna





# MacBook Pro (13-inch, M1, 2020) Tools and Fixtures

The following tools are required:

## ESD-Safe Workstation

- Grounded ESD Mat
- ESD wrist or heel strap with clip/plug
- ESD storage bags (for storing ESD-sensitive parts while removed from the unit)

## General Tools

- Antenna tool (923-01322)
- Battery cover (923-01318)
- Black stick
  - 922-5065 (4-pack)
  - 922-9004 (24-pack)
  - 922-9005 (96-pack)
- Bottom case removal/install fixture kit (076-00290), which includes:
  - Bottom case fixture
  - Quick grip clamps (2), also available separately (923-01369)
  - Nonslip gloves, small (pair), also available separately (923-01371)
  - Nonslip gloves, extra large (pair), also available separately (923-01370)
- Clean, soft, lint-free cloth (922-8245)
- ESD-safe tweezers
- Kapton tape (922-1731)
- Keycap lever (923-01803)
- Keycap tool kit (076-00457) which includes:
  - Keycap lever
  - Precut VHB adhesive strips.
- Suction cup (922-8252)
- Touch ID alignment tools (923-03032)
- Trackpad gap offset tools (923-02998)
- Trackpad calibration weights, 200 g and 800 g (923-00462)
- Weight Placement Rubber Template (923-04161)
- Pentalobe screwdriver (923-0731)
- Torx T3 screwdriver
- Torx T5 screwdriver
- Torx T8 screwdriver
- 3 mm hex nut driver
- 10–34 Ncm torque driver (923-02995)
  - T5 security bit (923-02996) (for use with 10–34 Ncm torque driver)
- Torque driver (blue), 0.65 kg-fcm (923-0448)
  - 1IPR security bit (923-0247) (for use with the Torque driver (blue), 0.65 kg-fcm)

## Miscellaneous Tools

- Compressed air (optional)
- Isopropyl alcohol (IPA) wipe
- Magnifying glass (optional, for reading serial number)
- Nonslip gloves, medium/large (pair), (923-01368) (optional)
- Sticky notes

# Take-Apart Procedure Notes

## Reassembly Steps

When the take-apart procedure doesn't include a final list of parts that you need to reinstall to complete reassembly, reinstall parts in the reverse order in which they're listed in the beginning of the Removal section.

## Images

Some service guide articles include images of preproduction devices. There may be small differences between the image shown and the device you're servicing, but the procedures are the same unless noted.

## Screw Sizes

All screw sizes are about the total length of the screw.



# MacBook Pro (13-inch, M1, 2020) Bottom Case

## First Steps



### Warning:

- To avoid damaging parts, install the battery cover, disconnect the battery flex cable, and remove the BMU screw before you begin a repair.
- Don't connect the computer to an external power source during repair.

### Important:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- [Follow ESD guidelines](#) (OP100).
- [Follow battery safety precautions](#) (TP772) before repairing the bottom case.

### Perform the following steps before starting the repair:

- Shut down the computer.
- Unplug all cables.
- Put on an ESD wrist strap.
- Place the computer facedown on a clean, flat surface.



## Tools

- ESD wrist strap
- Pentalobe screwdriver (923-0731)
- Battery Cover for MacBook Pro (13-inch, M1, 2020) (923-01318)
- Bottom case removal kit (076-00290)
- Fine-tip permanent marker
- Suction cup (922-8252)
- Clean, soft, lint-free cloth (not shown)



## Steps For Removal

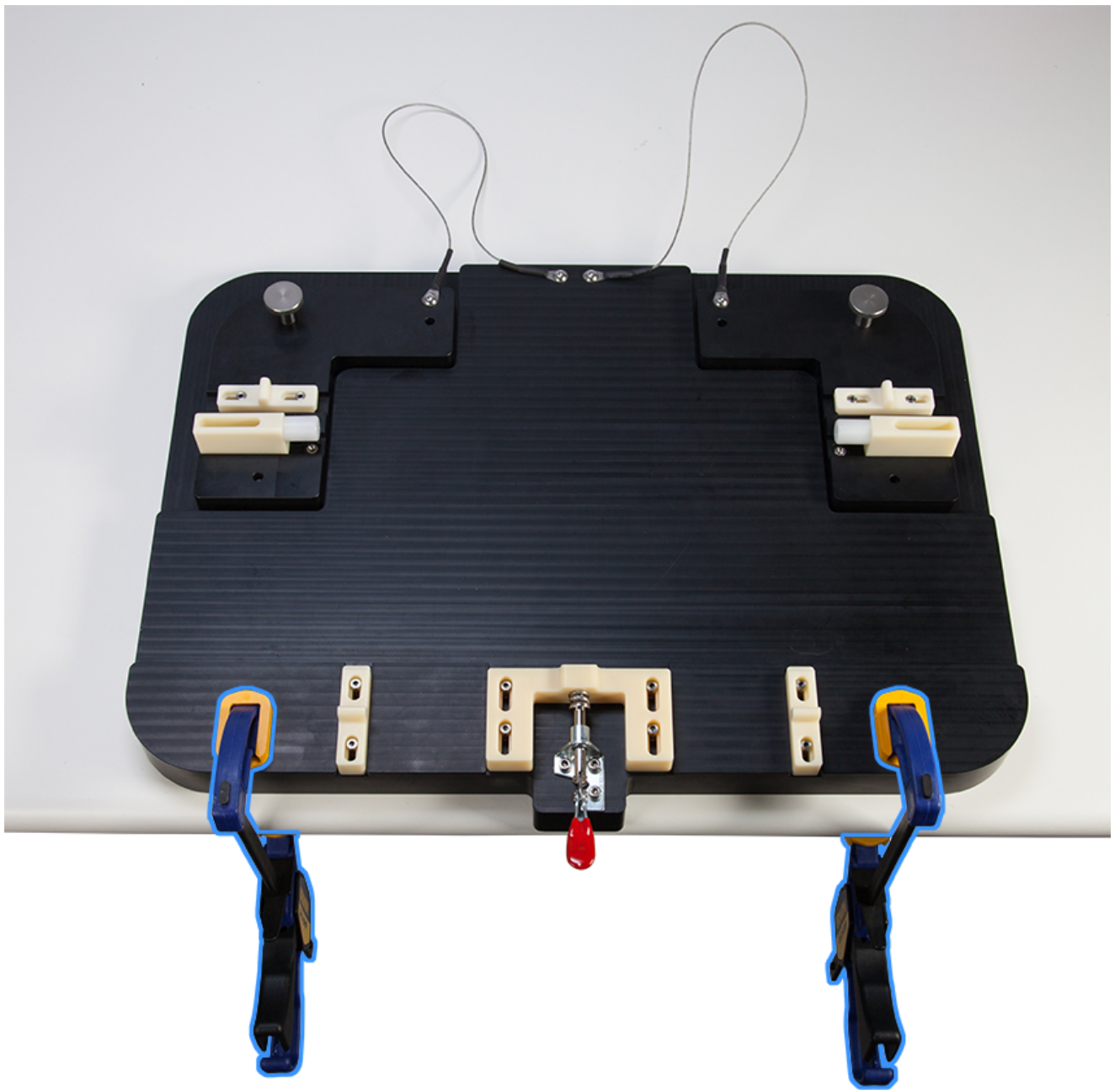
1. Remove the six Pentalobe screws from the bottom case.

Color	Screw #1	Screw #2	Screw #3
Space Gray	923-05200	923-05201	923-05202
			
Silver	923-05203	923-05204	923-05205
			



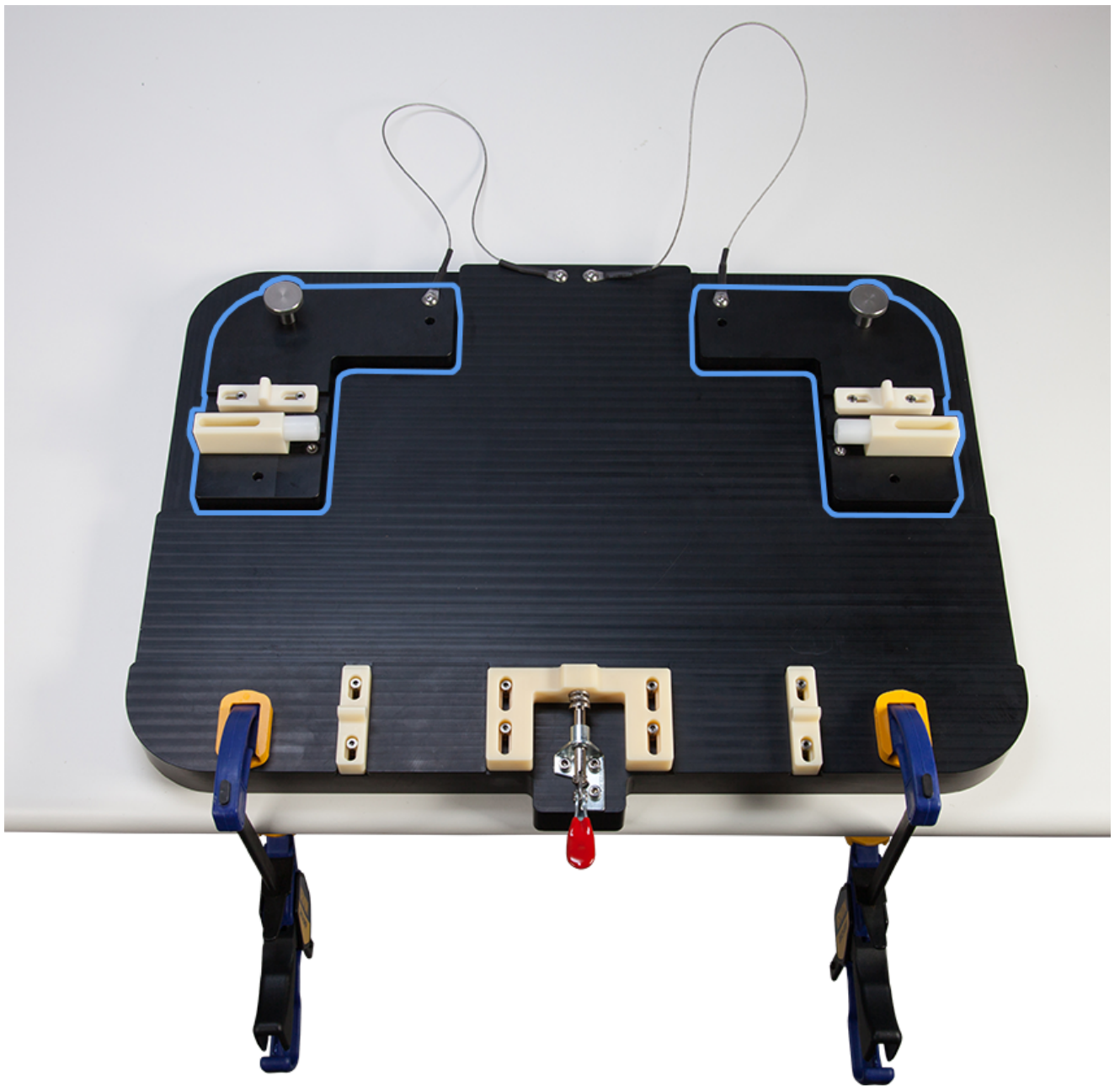
2. Use two clamps to secure the bottom case fixture to the table. Squeeze the clamp handles to tighten the clamps. Ensure that the sliding bars of the clamps are below the table.





3. Position the bottom case fixture with the red lever at the bottom and the tethered corner braces at the top, adjusted inward to fit a 13-inch MacBook Pro.

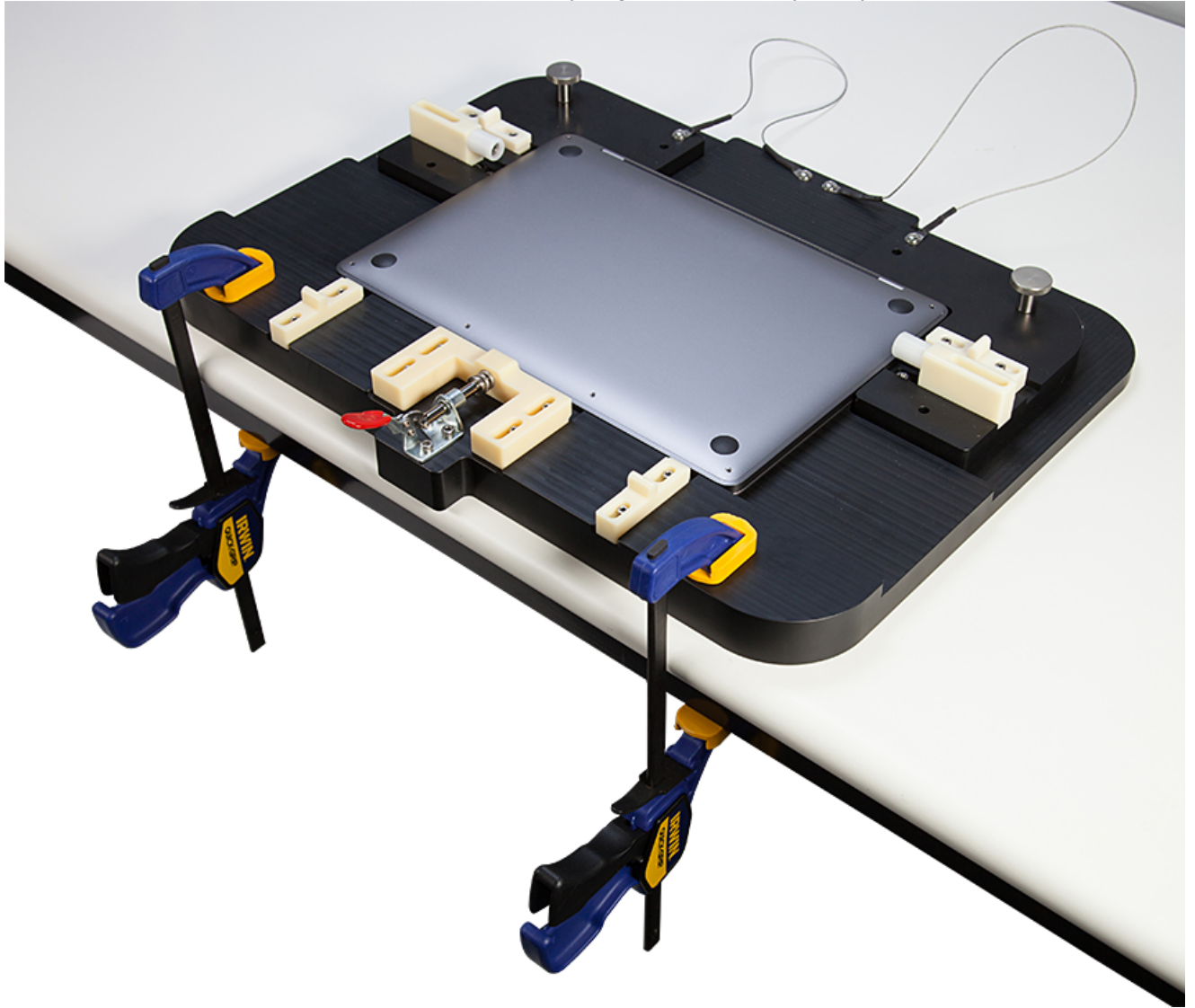




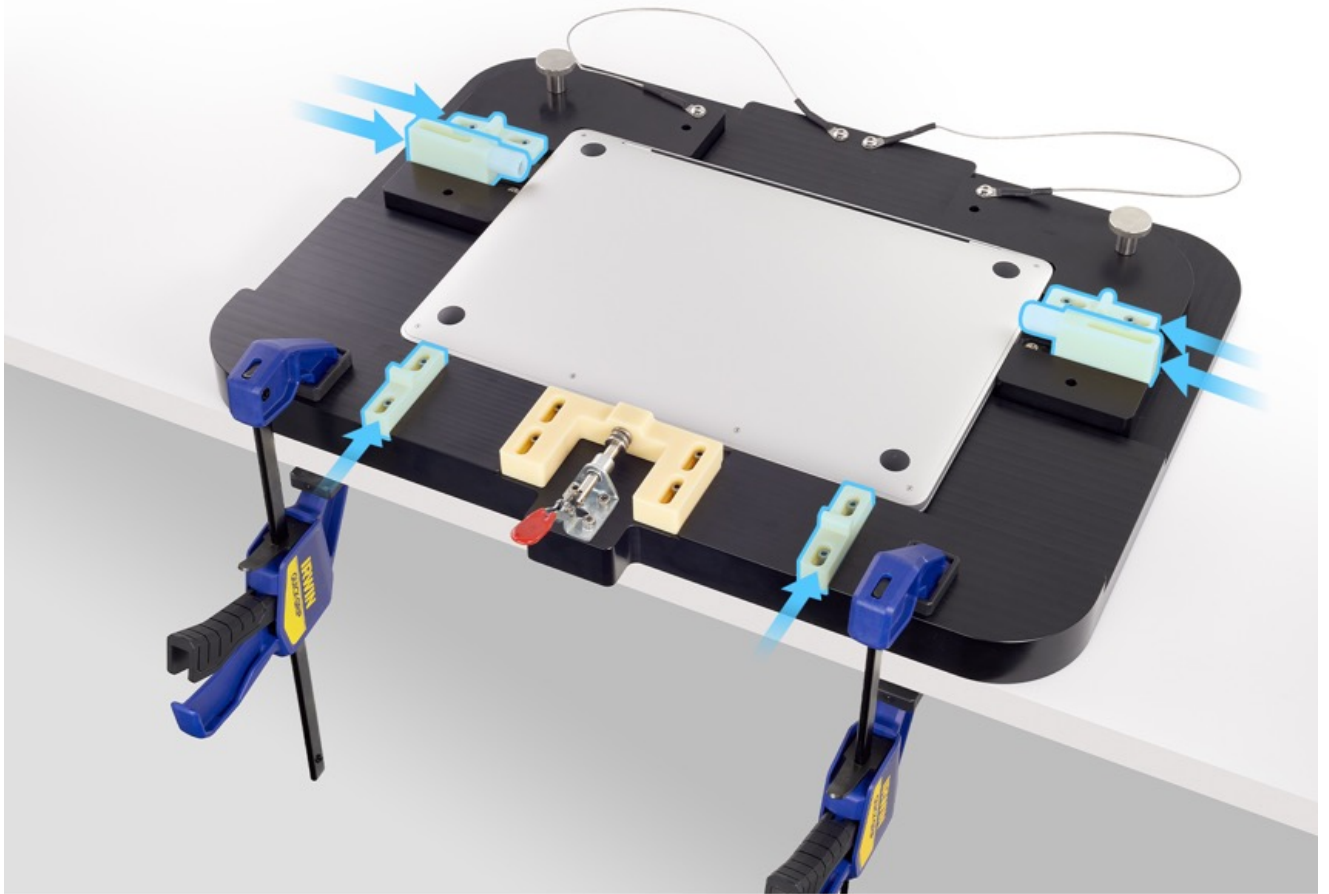
4. Tighten the silver thumbscrews.



5. Place the computer facedown in the fixture with the display hinge at the top, away from you.

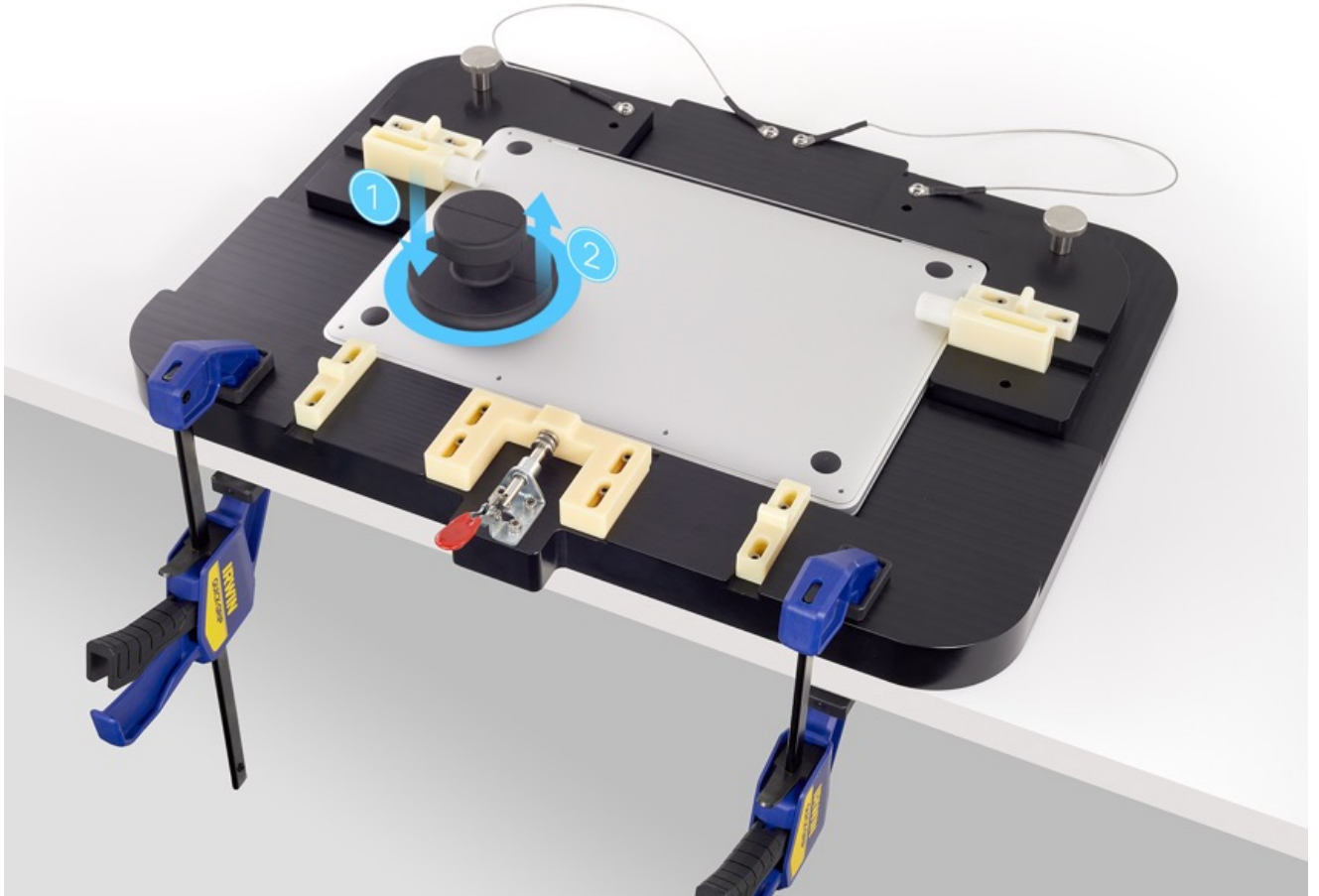


6. Push the four sliding locks and two rollers inward to hold the computer in place. Ensure that the red lever is fully open and faces toward you.



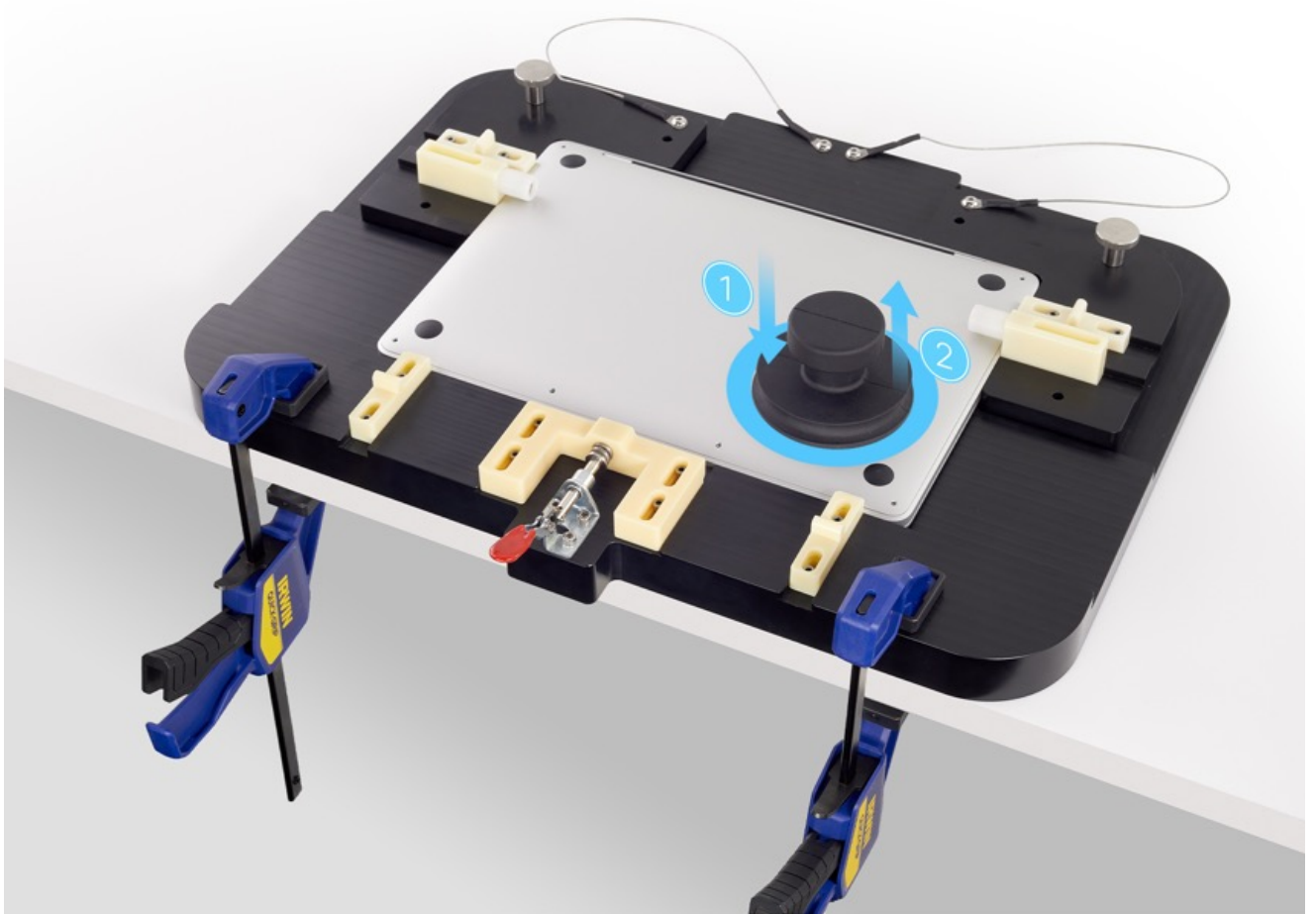
7. Put on the gloves. Then, press the suction cup to attach it to the lower left corner of the bottom case (1). Pull up on the suction cup handle just high enough (about 0.5 cm or 2 inches) to lift the bottom case and release two clips underneath the bottom case (2).

**Caution:** Do not insert a black stick into the opening or you could damage the battery.



8. Peel the edges of the suction cup to release it. Move the suction cup to the lower right corner of the bottom case and press the top to attach it (1). Pull up on the suction cup handle just high enough (about 0.5 cm or 2 inches) to release the remaining two interior clips (2), as done previously with the left side.





9. Remove the suction cup. Insert your index fingers into the narrow opening at the edges closest to you.  
**Caution:** To protect the computer, keep the opening no more than a finger's width apart.



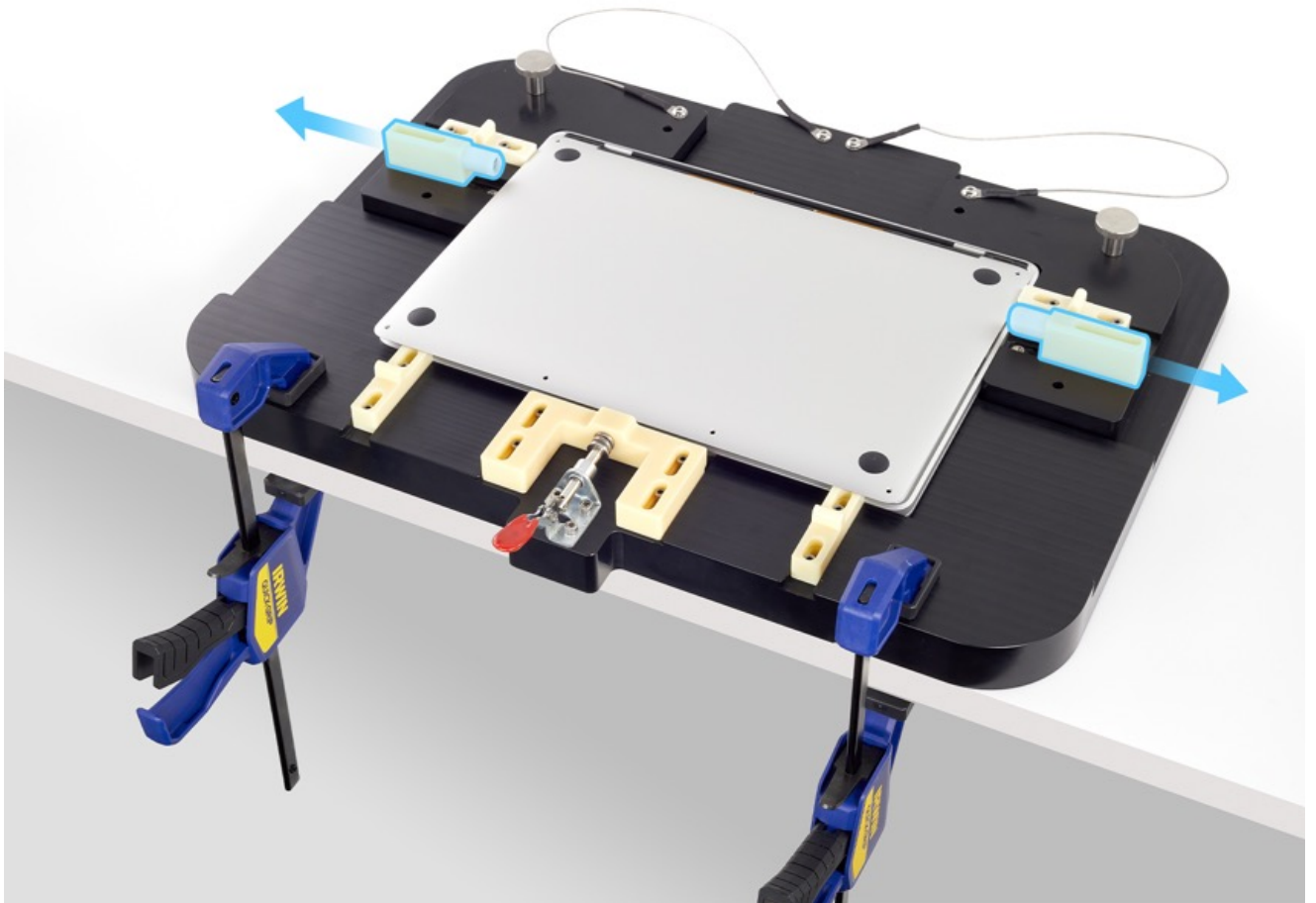
10. Position both hands in the recessed areas of the fixture to protect the internal parts when you remove the bottom case. Apply gentle and steady pressure to slide the bottom case toward you by less than 1.27 cm or 0.5 inches to disengage the spring fingers. Wiggle the case slightly if needed. The spring fingers secure the bottom case and can release suddenly.  
**Caution:** Ensure that you don't drag the bottom case over internal parts when sliding it.



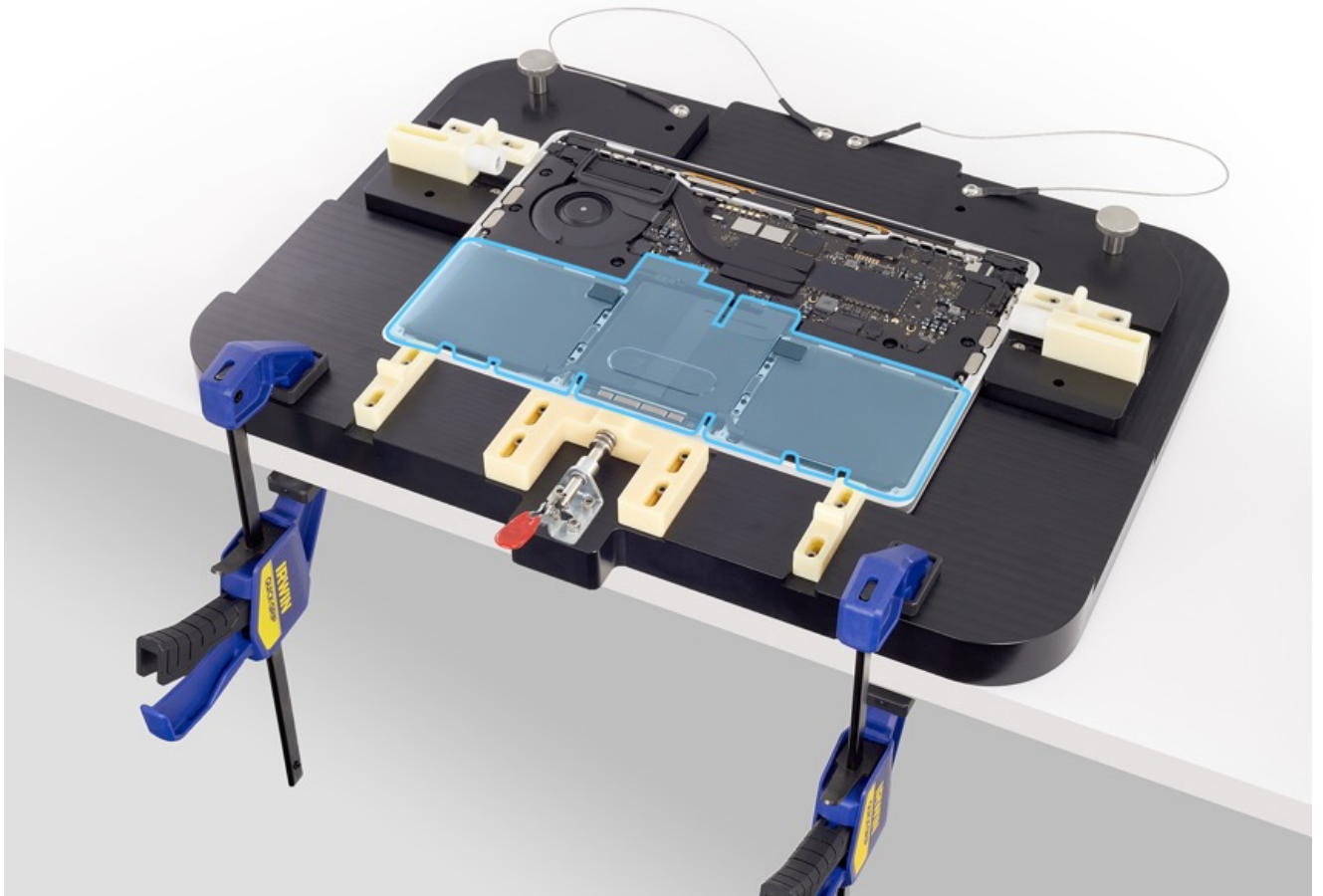
11. Rest the bottom case on the top case.



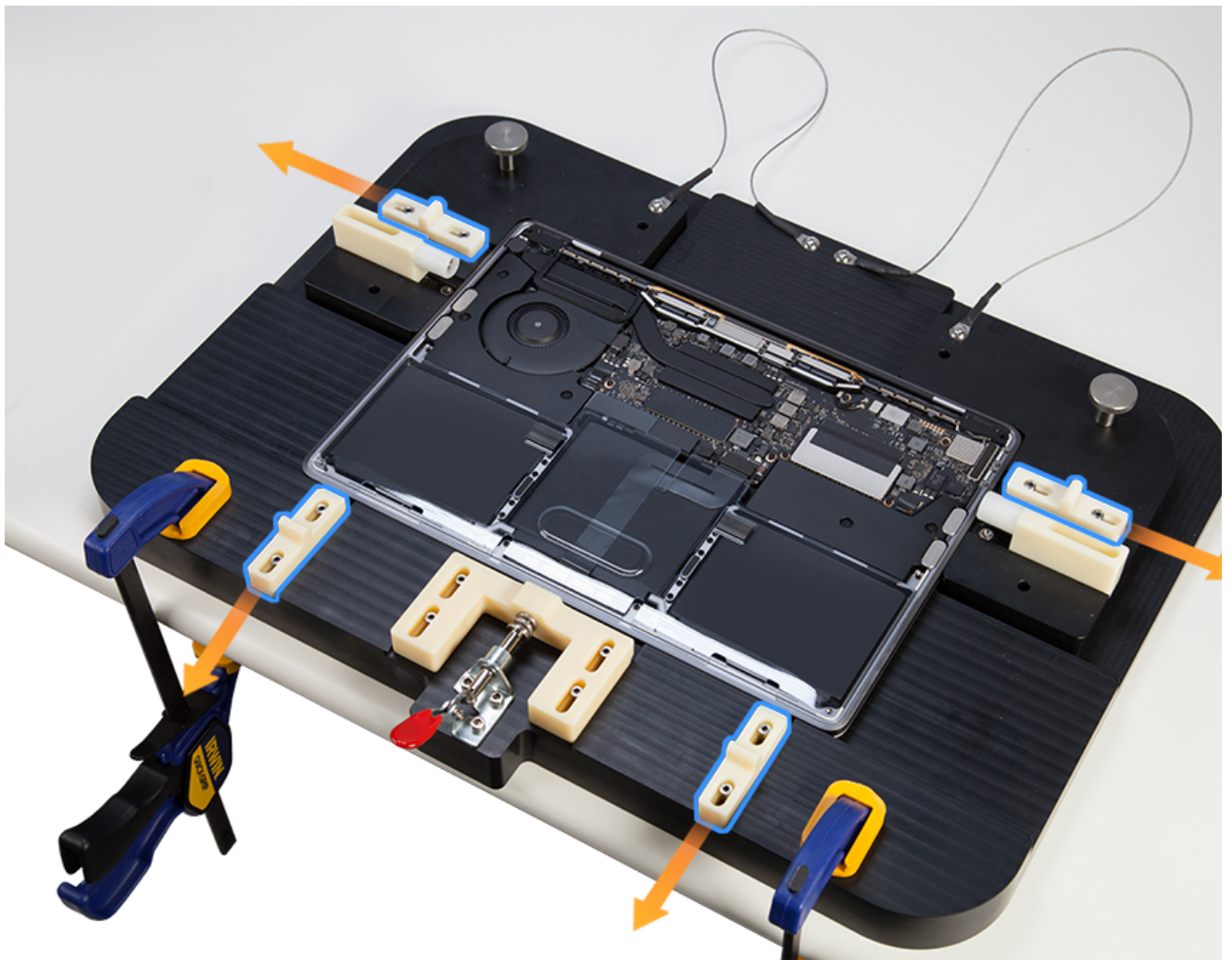




13. Place the battery cover on the battery. Tuck the bottom edge of the battery cover under the edge of the top case and press down on the clips to attach the battery cover to the top case.



14. If you're replacing just the bottom case, go to the reassembly instructions. If you're performing an additional repair on the computer, don't perform that repair while the computer is in the bottom case fixture. Instead, release the four sliding locks, then lift the computer from the bottom case fixture. Then transfer the computer to an ESD-safe surface.



15. [Disconnect the battery](#) (RP1693).

### Steps For Reassembly

1. The replacement bottom case comes with a red tube that runs through the airloops. Grasp one end of the red tube, pull it out of the airloop gasket and discard it. The tube is only used for shipment.





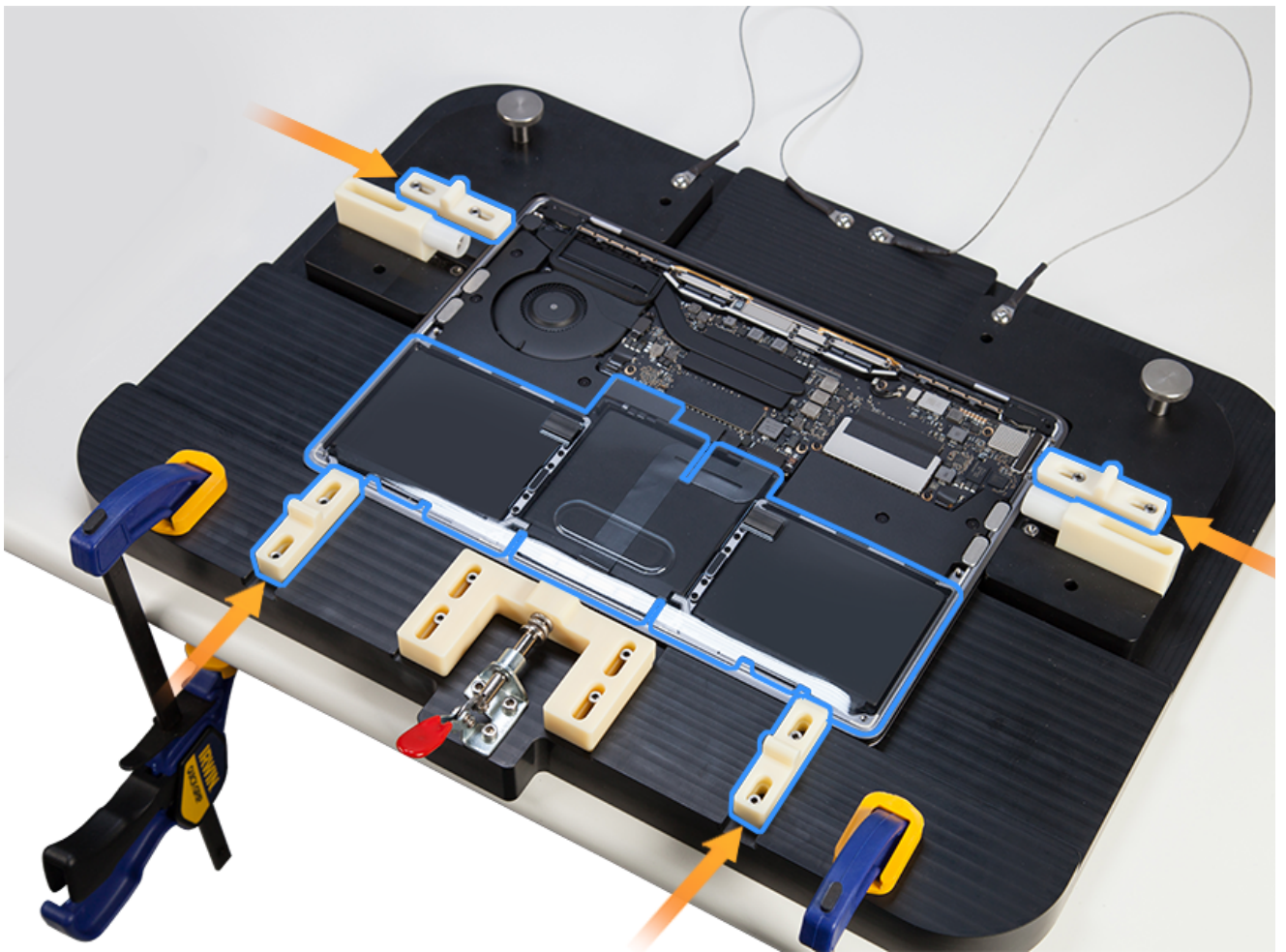
2. Retain the original bottom case until you complete the repair. Use a fine-tip permanent marker to write the system serial number on the inside of the replacement bottom case.



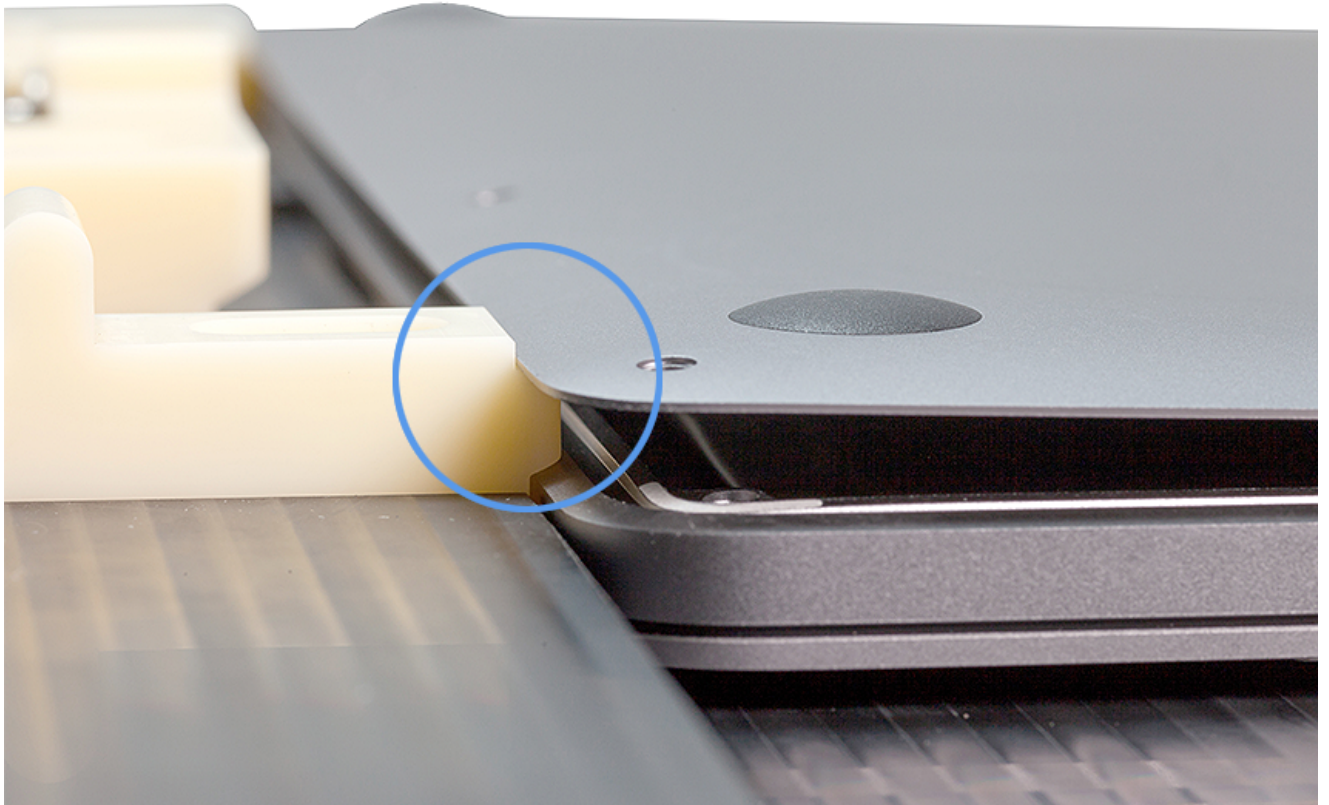


3. Place the computer on the bottom case fixture. Ensure that the display hinge is at the top, away from you.
4. Engage the four sliding locks in and remove the battery cover.



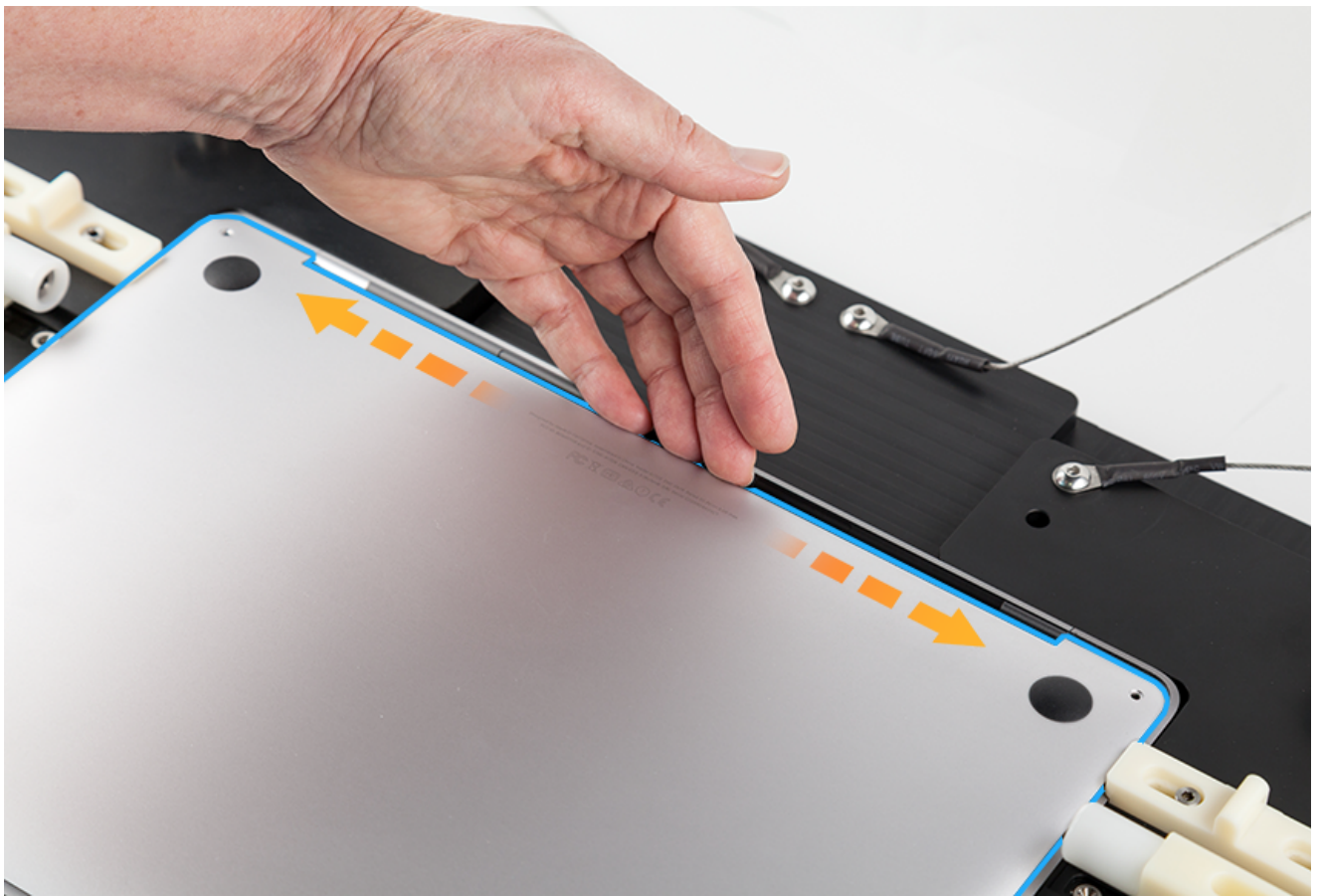


5. Position the bottom case so that its front edge rests on top of the lower two sliding locks.



6. Align the back of the bottom case with the vent/antenna module. The long edge of the bottom case should be flush with the smooth plane of the vent/antenna module.



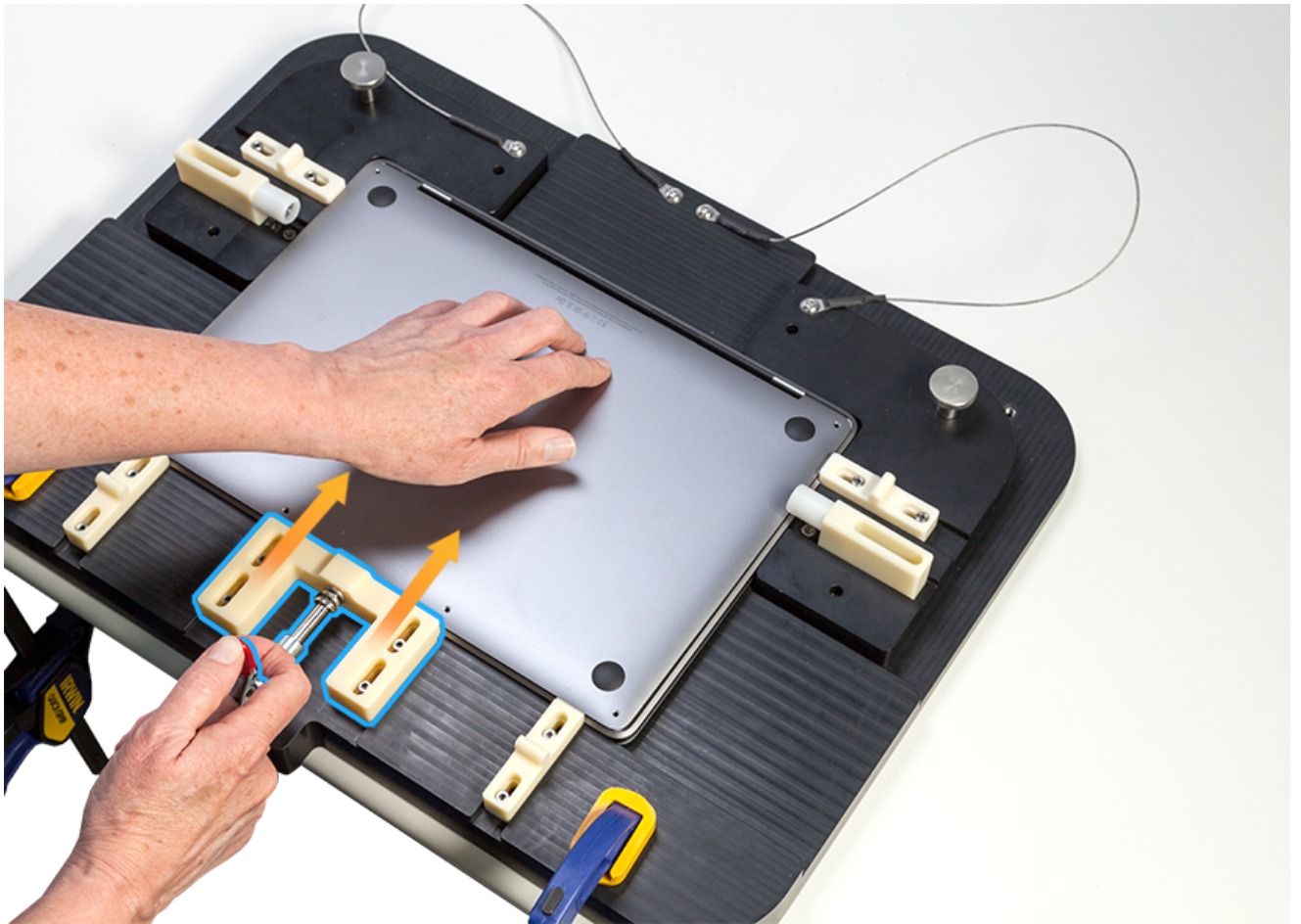


**Important:** The notches at each rear corner should show an equal gap, indicating that the two rows of spring fingers inside the bottom case are aligning with the metal tabs on the vent wall.

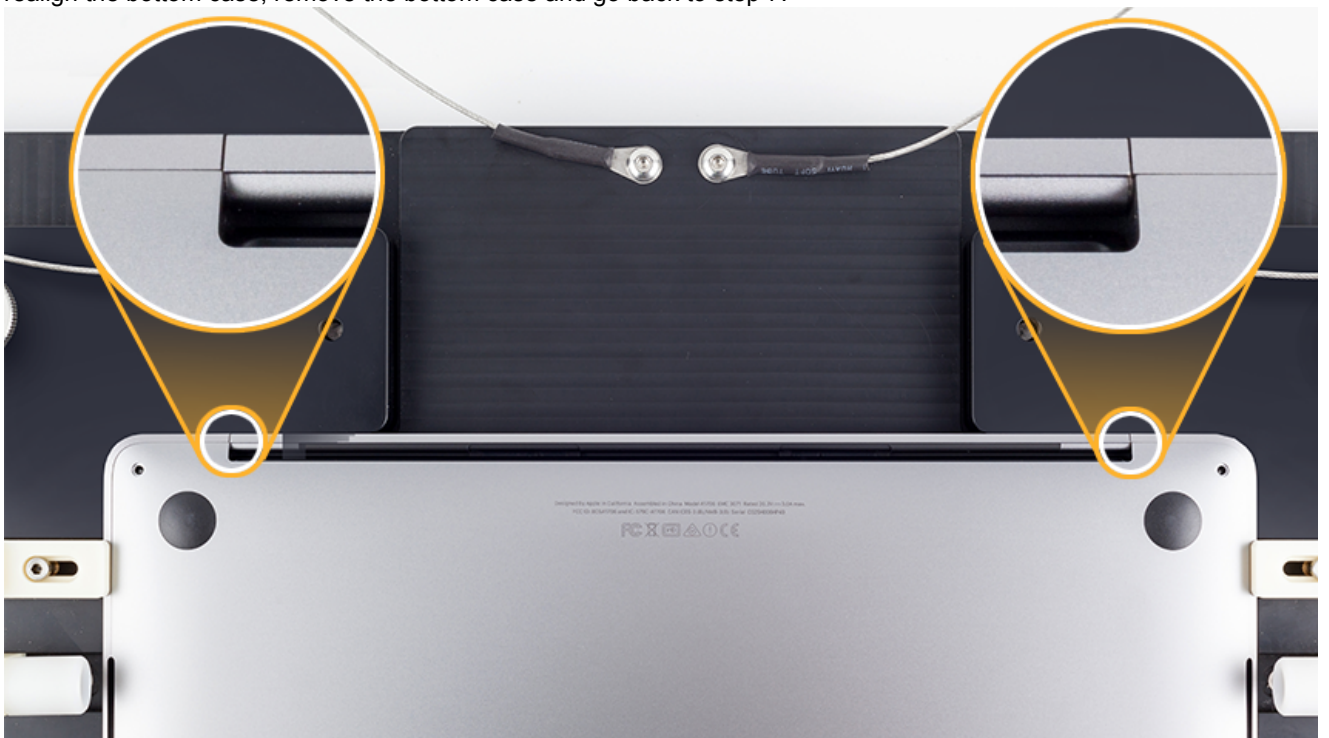


7. Lightly press near the back center edge of the bottom case while slowly engaging the red lever. Feel the spring fingers engage slightly as you press the bottom case.

**Caution:** Pushing the red lever all the way can distort the bottom case and the lever spring.

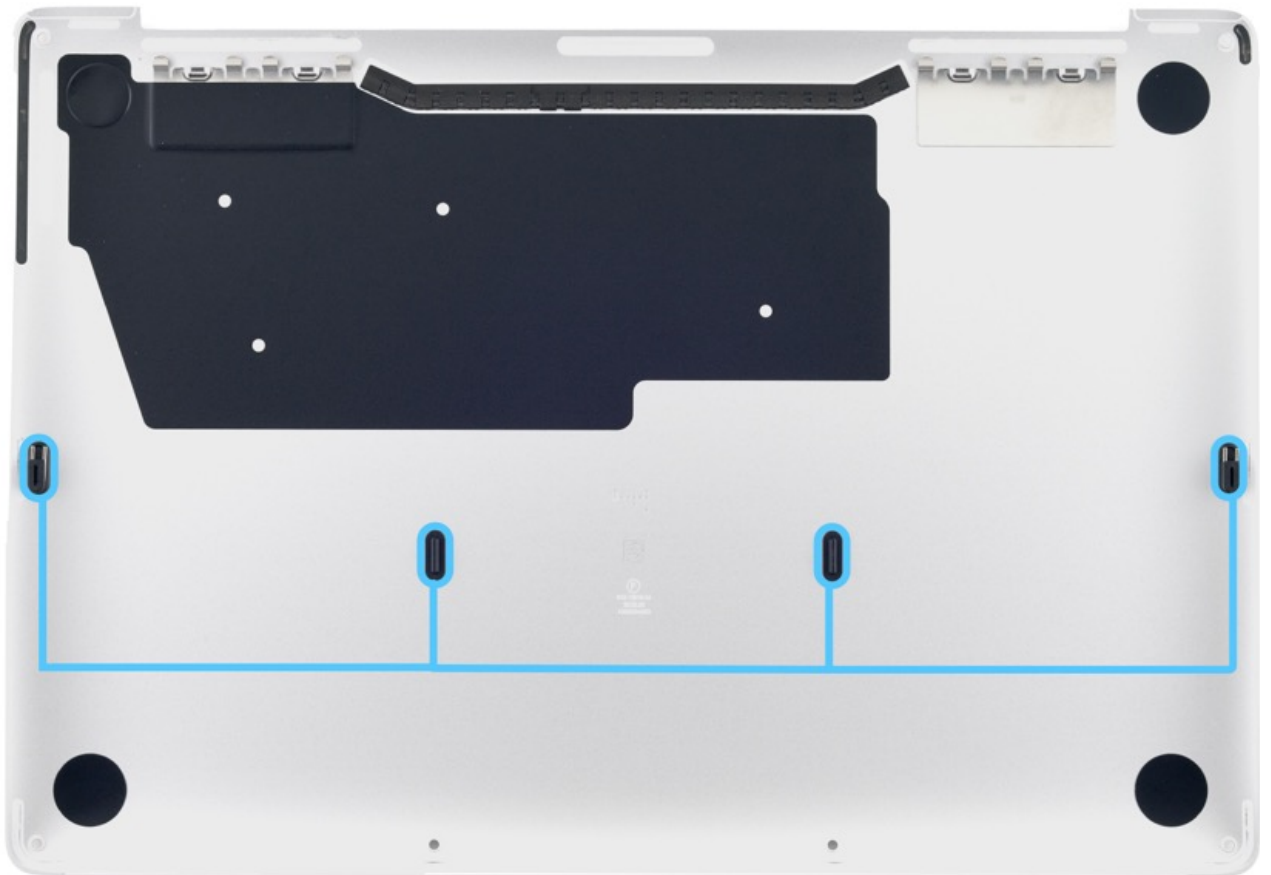
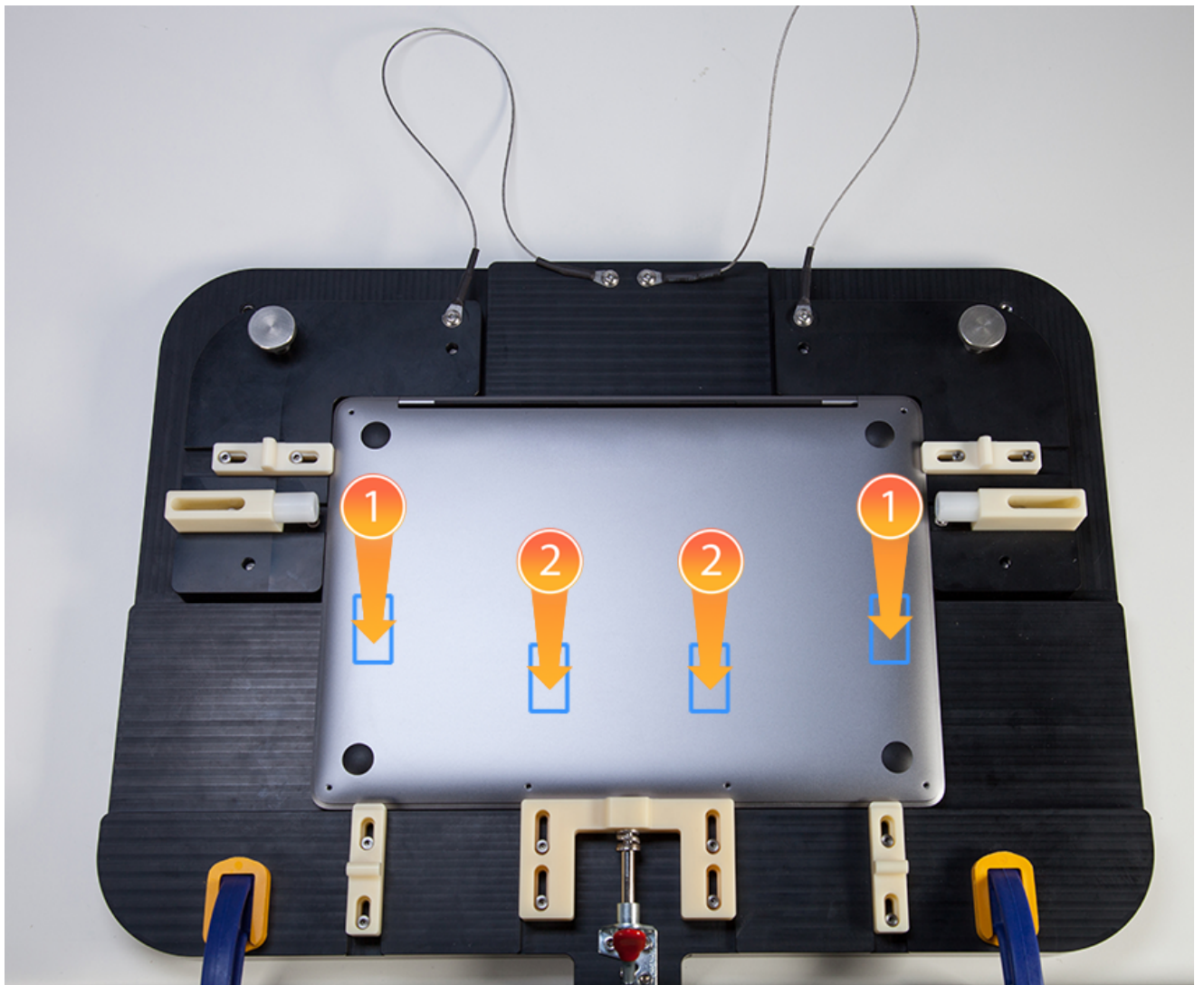


8. Disengage the lever as the rear corners of the bottom case meet the top case corners. If the bottom case is slightly misaligned, wear gloves and gently press the bottom case to adjust it into alignment. If applying pressure doesn't realign the bottom case, remove the bottom case and go back to step 7.

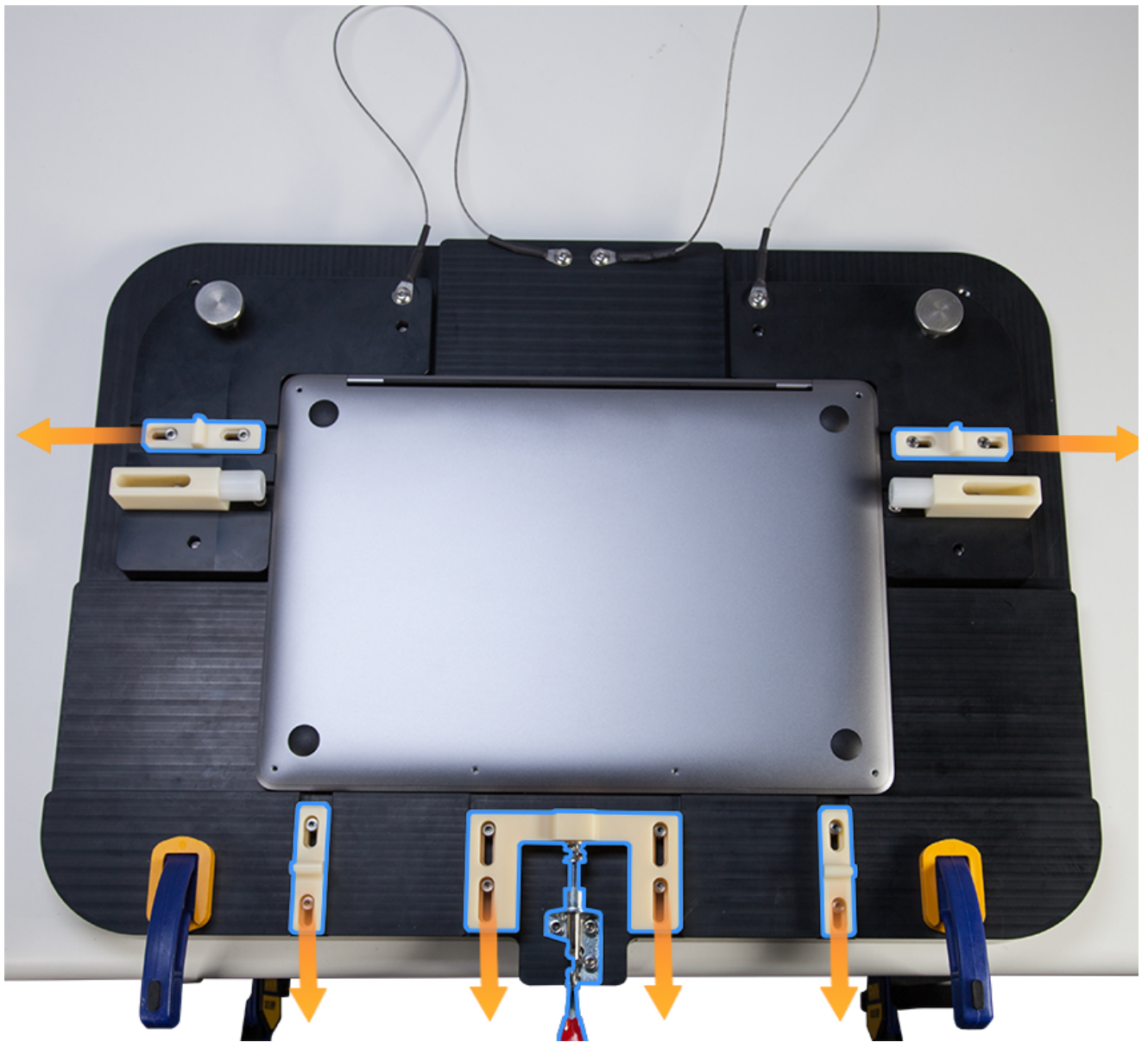


9. Press the sides of the bottom case to reattach the two interior clips (1) in the top case. Then press the middle of the bottom case to reattach the remaining two interior clips (2).

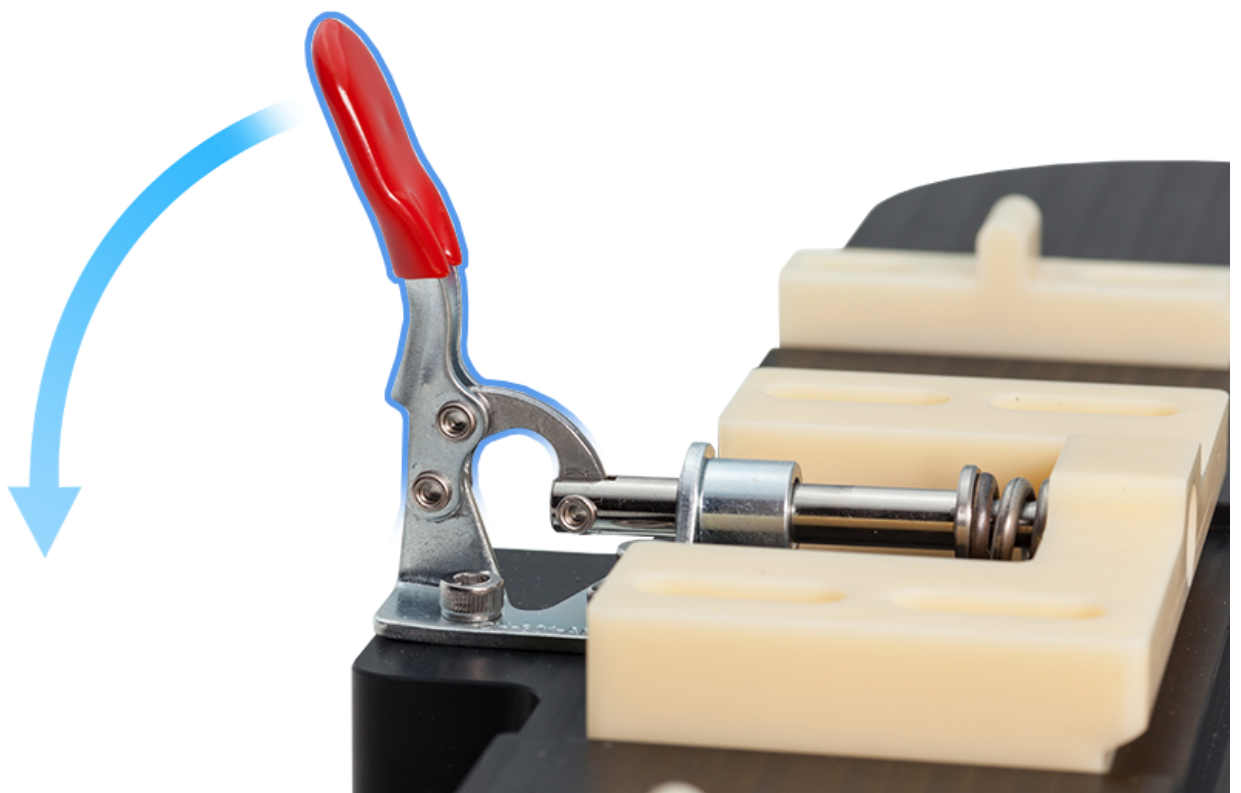




10. Push the sliding locks outward. Pull the red lever to release the final lock.

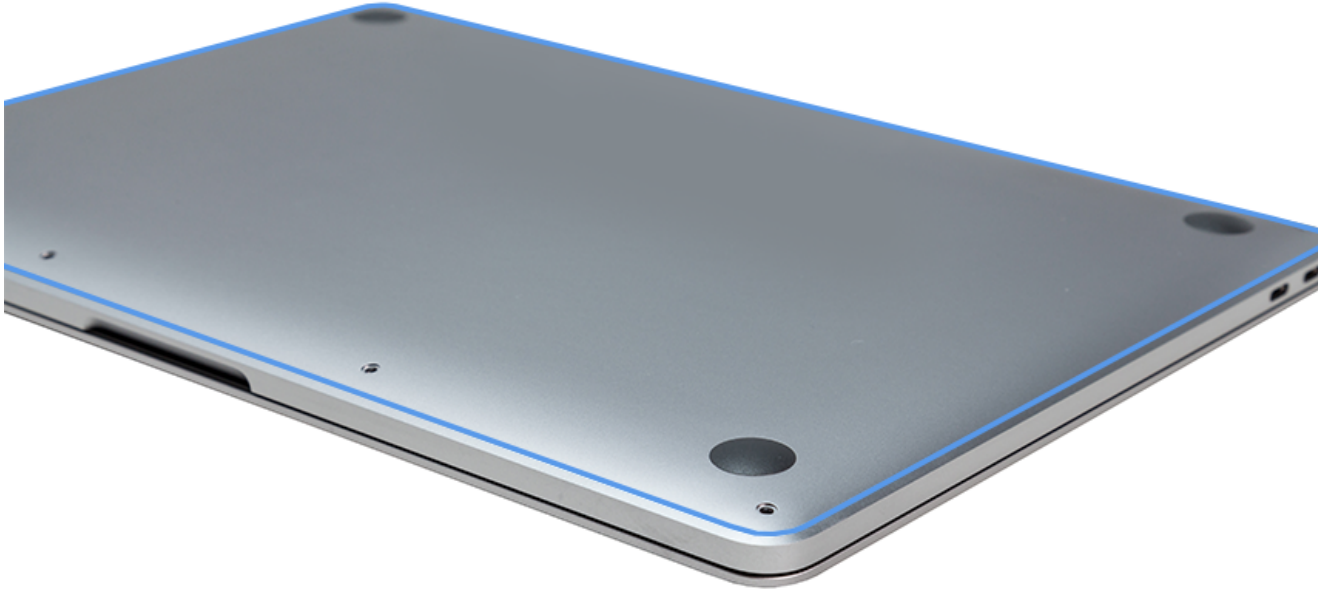


11. Remove the computer from the bottom case fixture. Fully disengage the red lever to protect its inner spring when storing the bottom case fixture.



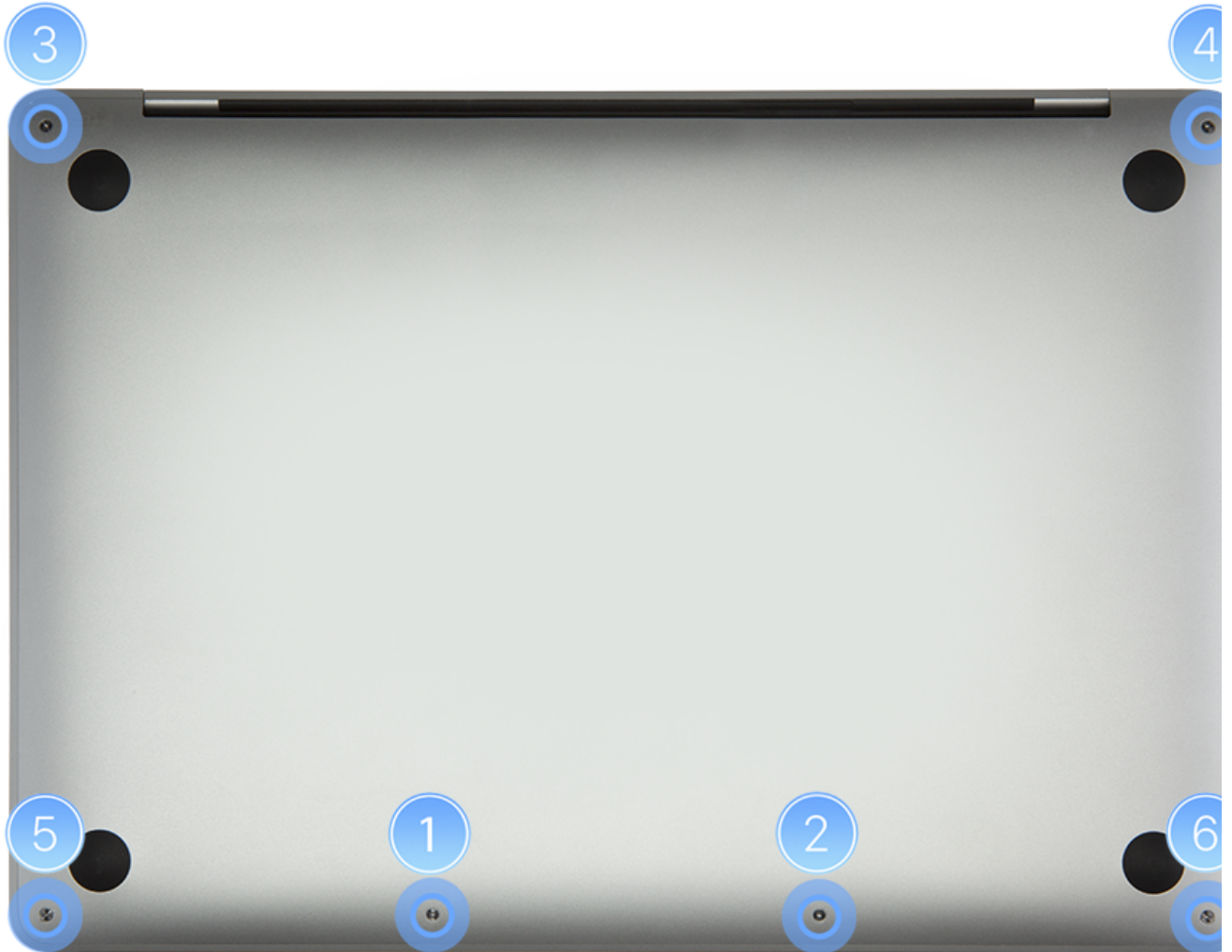


12. Check all sides of the bottom case for proper alignment with the top case.



13. Reinstall the six screws in the bottom case in the order shown:

1. Short screws at the middle front (1), (2)
2. Long screws at the rear corners (3), (4)
3. Medium-length screws at the front corners (5), (6)



14. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# MacBook Pro (13-inch, M1, 2020) Battery Cover and Disconnecting the Battery

## First Steps

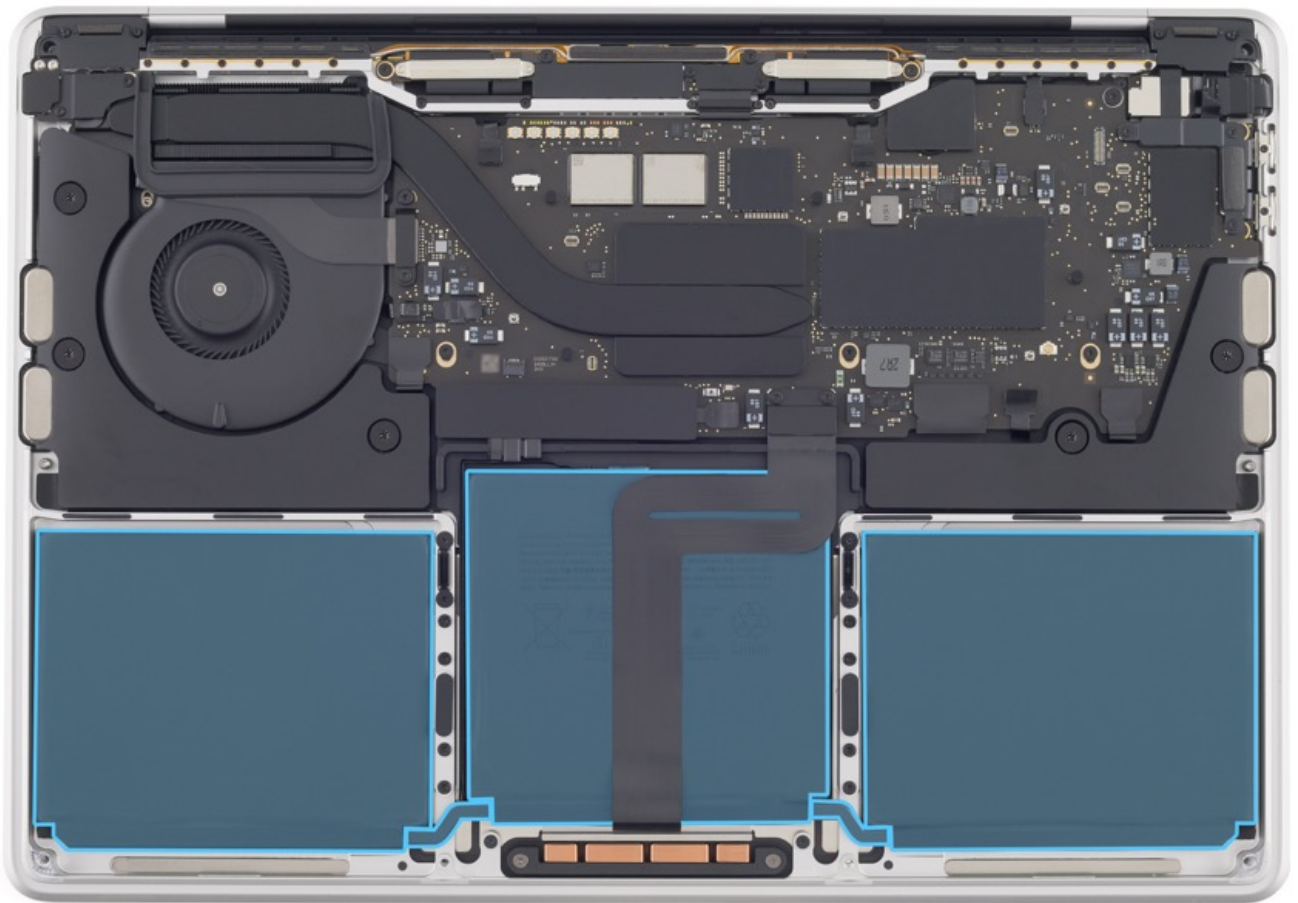


### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, complete the removal steps of this procedure before you begin any other repair.
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- [Bottom Case](#)



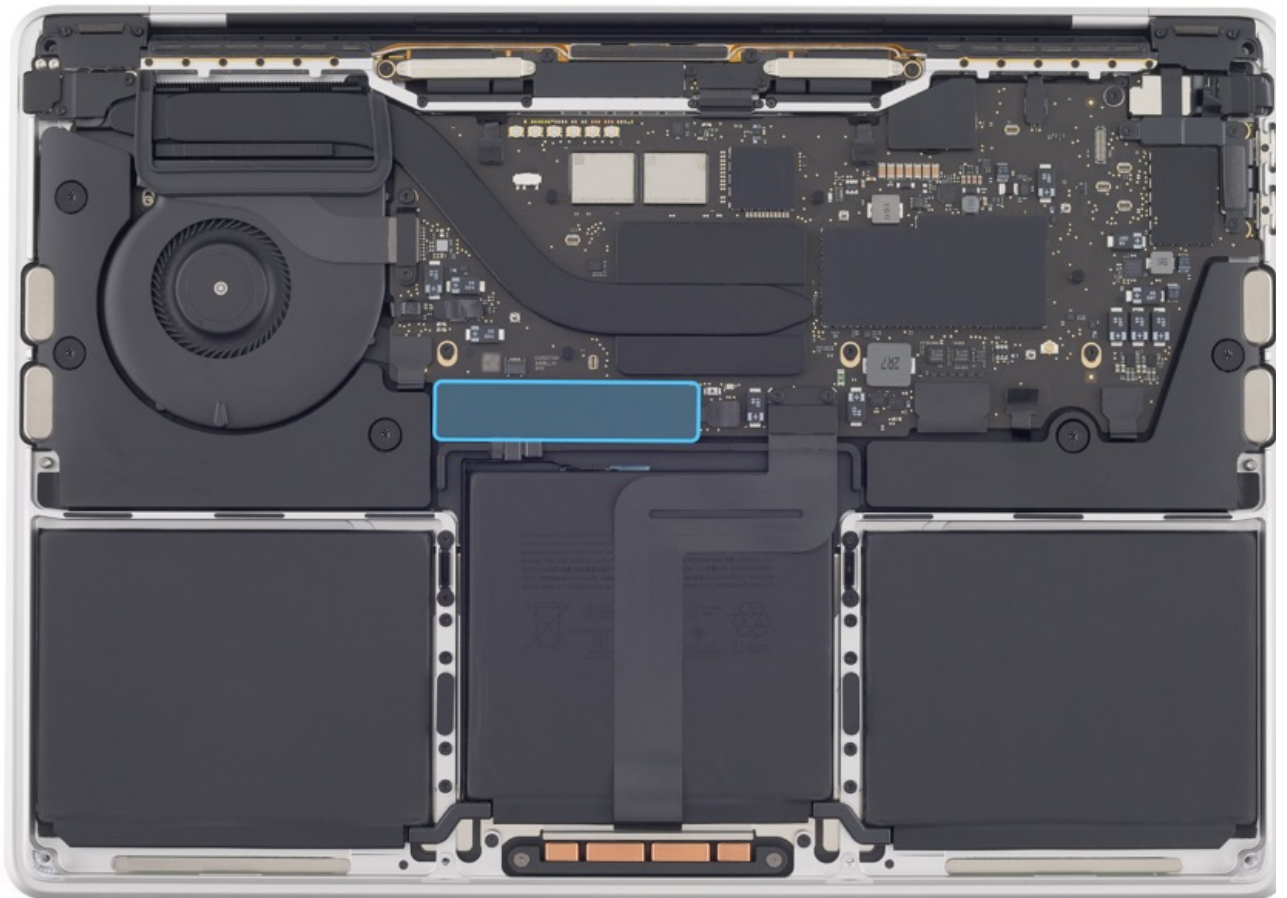
## Tools

1. Black stick
2. Torx T5 screwdriver
3. ESD-safe tweezers (optional)
4. ESD wrist strap
5. Battery cover (923-01318)



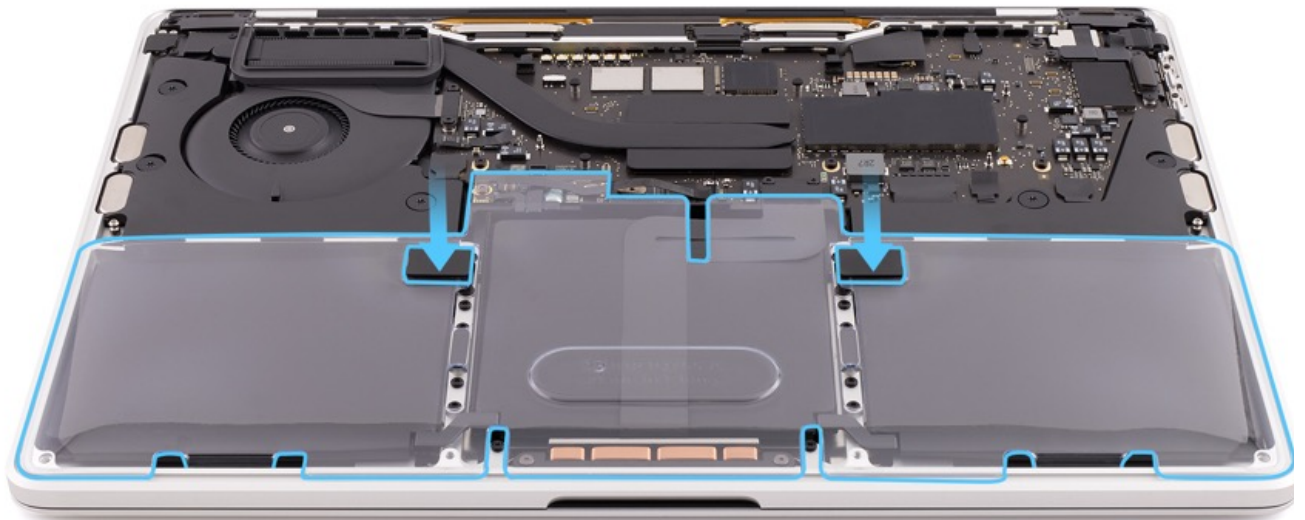
## Steps For Removal

1. The battery management unit (BMU) Mylar cover is held in place by adhesive foam pads. Use the flat end of a black stick to lift the BMU Mylar cover off the BMU board, then set it aside for reuse.  
**Important:** Some replacement parts include a new BMU Mylar cover. Always install a new BMU Mylar cover if one is provided.

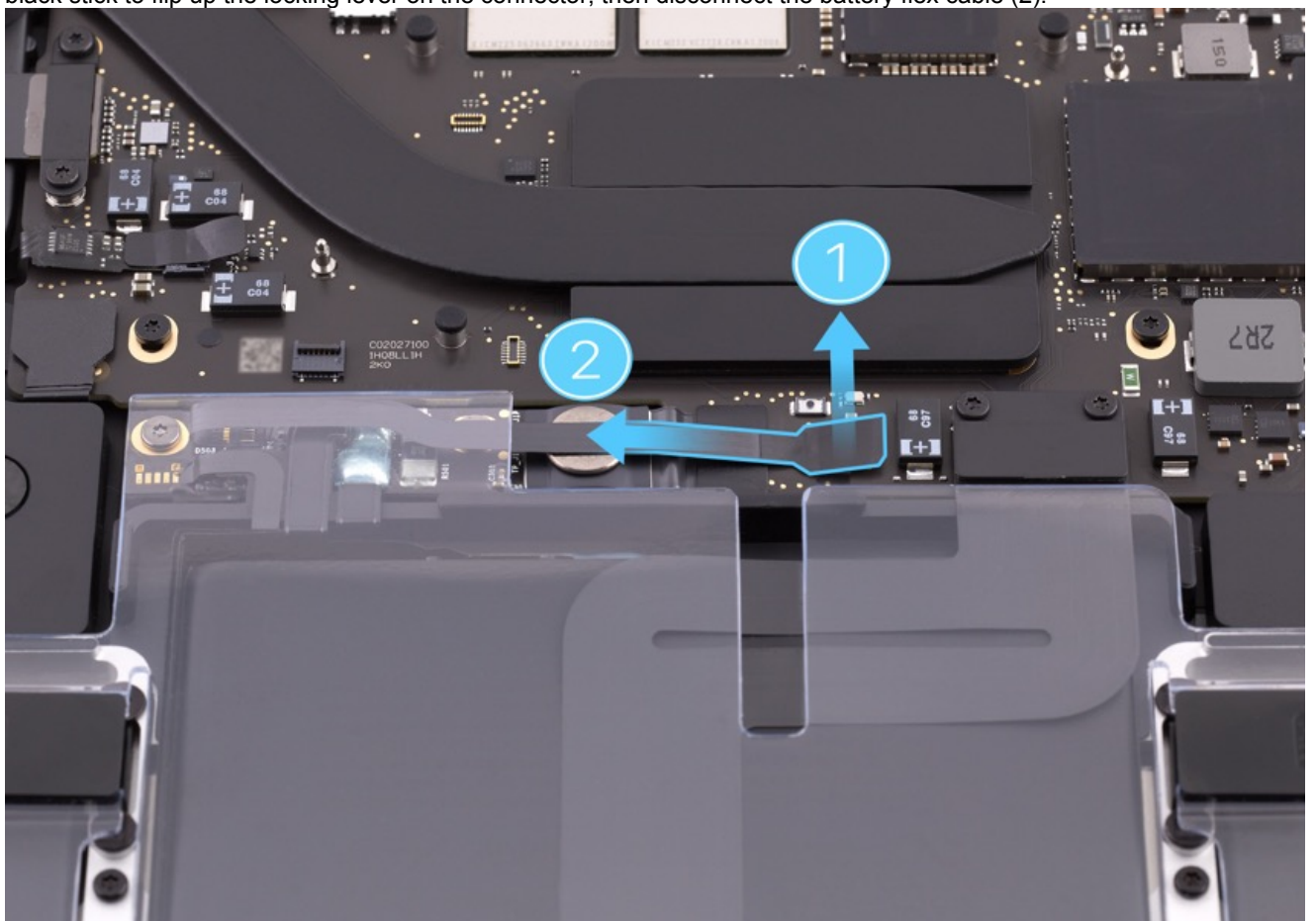


2. Tuck the bottom edge of the battery cover under the edge of the top case. Press down on the clips to attach the battery cover to the top case.

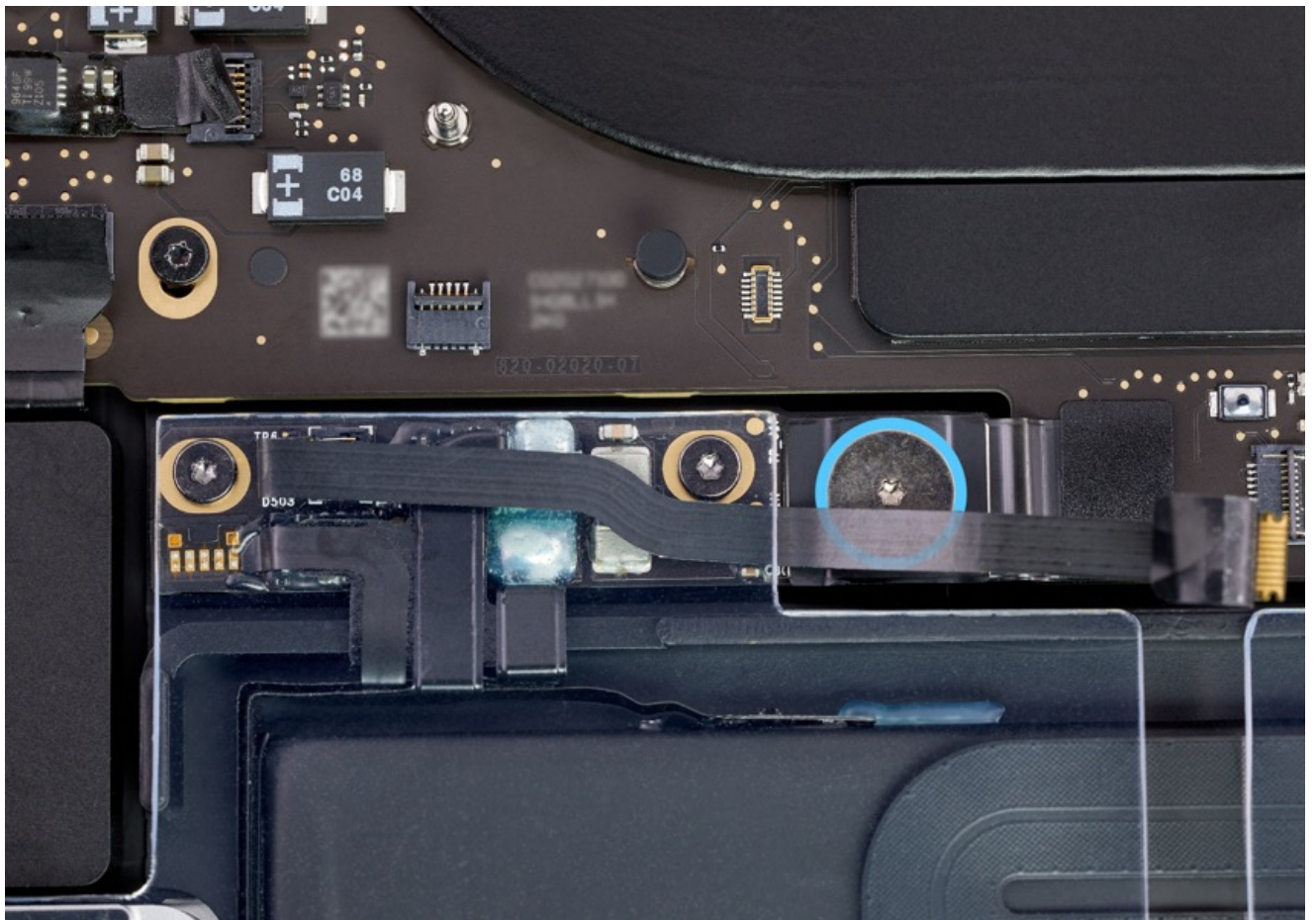




3. To disconnect the battery peel up the pull tab (1) covering the locking lever on the battery flex cable connector. Use a black stick to flip up the locking lever on the connector, then disconnect the battery flex cable (2).



4. Remove the T5 screw from the BMU board. This disconnects the battery.

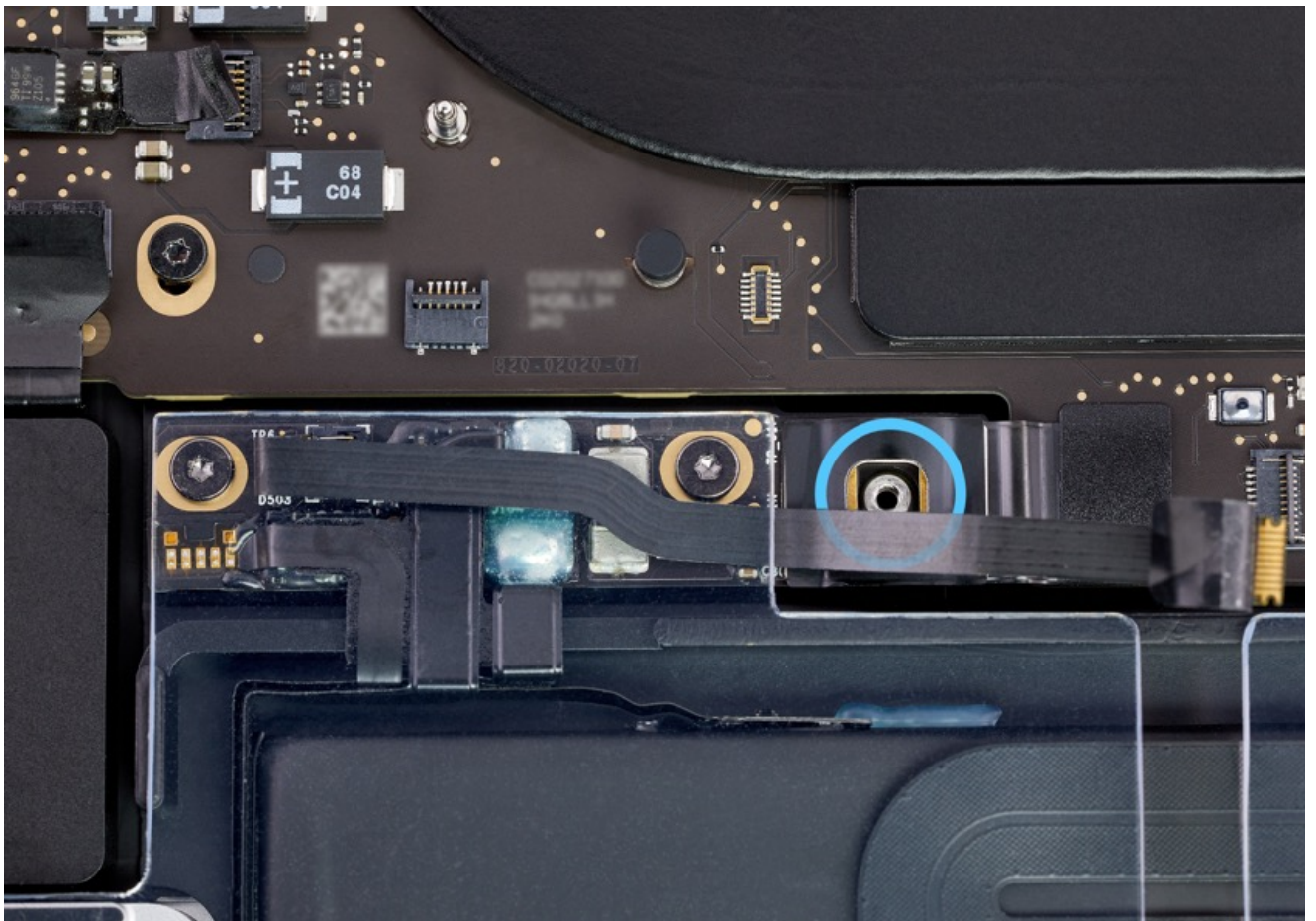


## Steps For Reassembly

1. Reinstall the T5 screw (923-05241) in the BMU board.

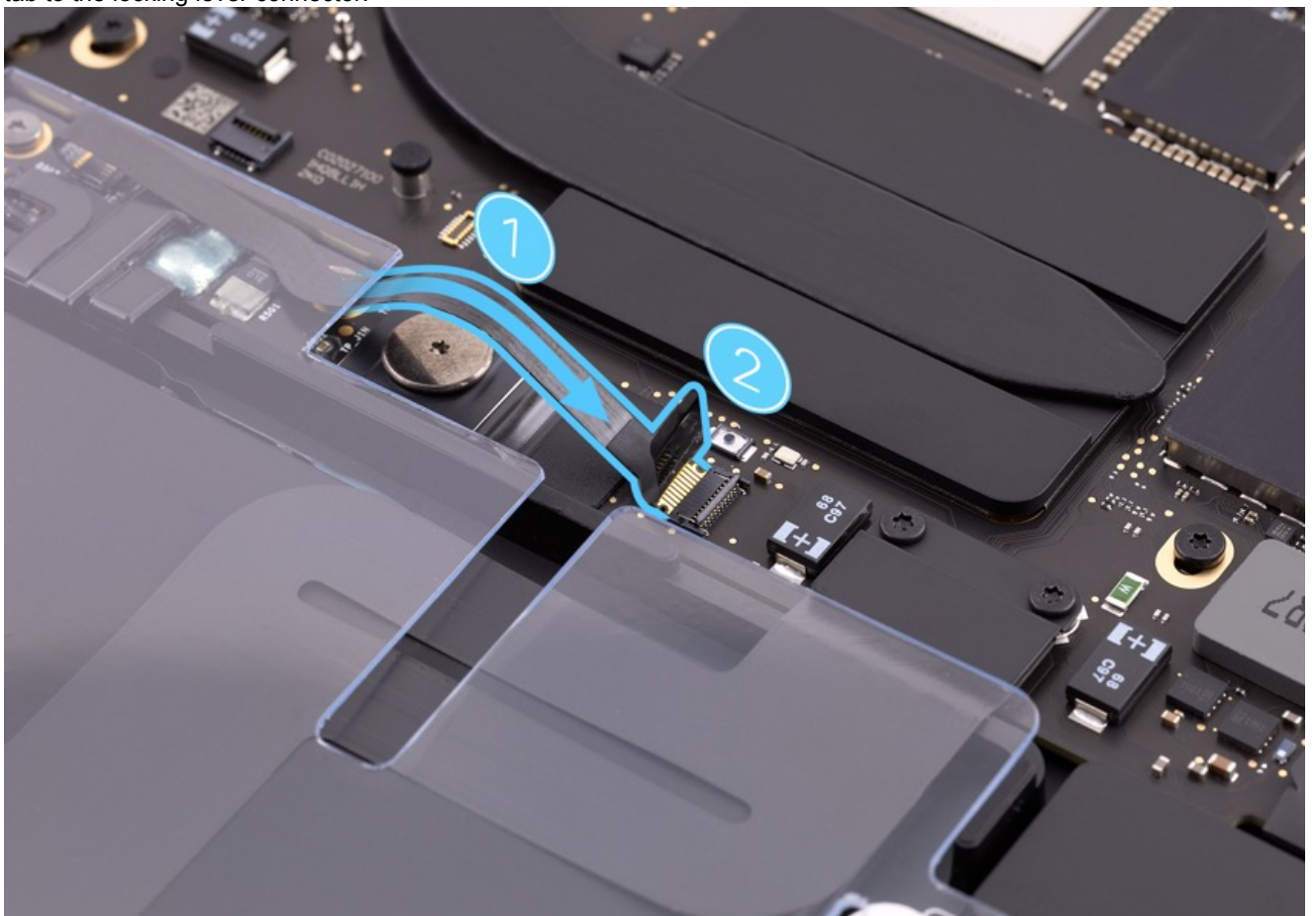






2. Reconnect the battery flex cable. Use the flat end of a black stick to close the locking lever. Adhere the pull tab over the locking lever connector.

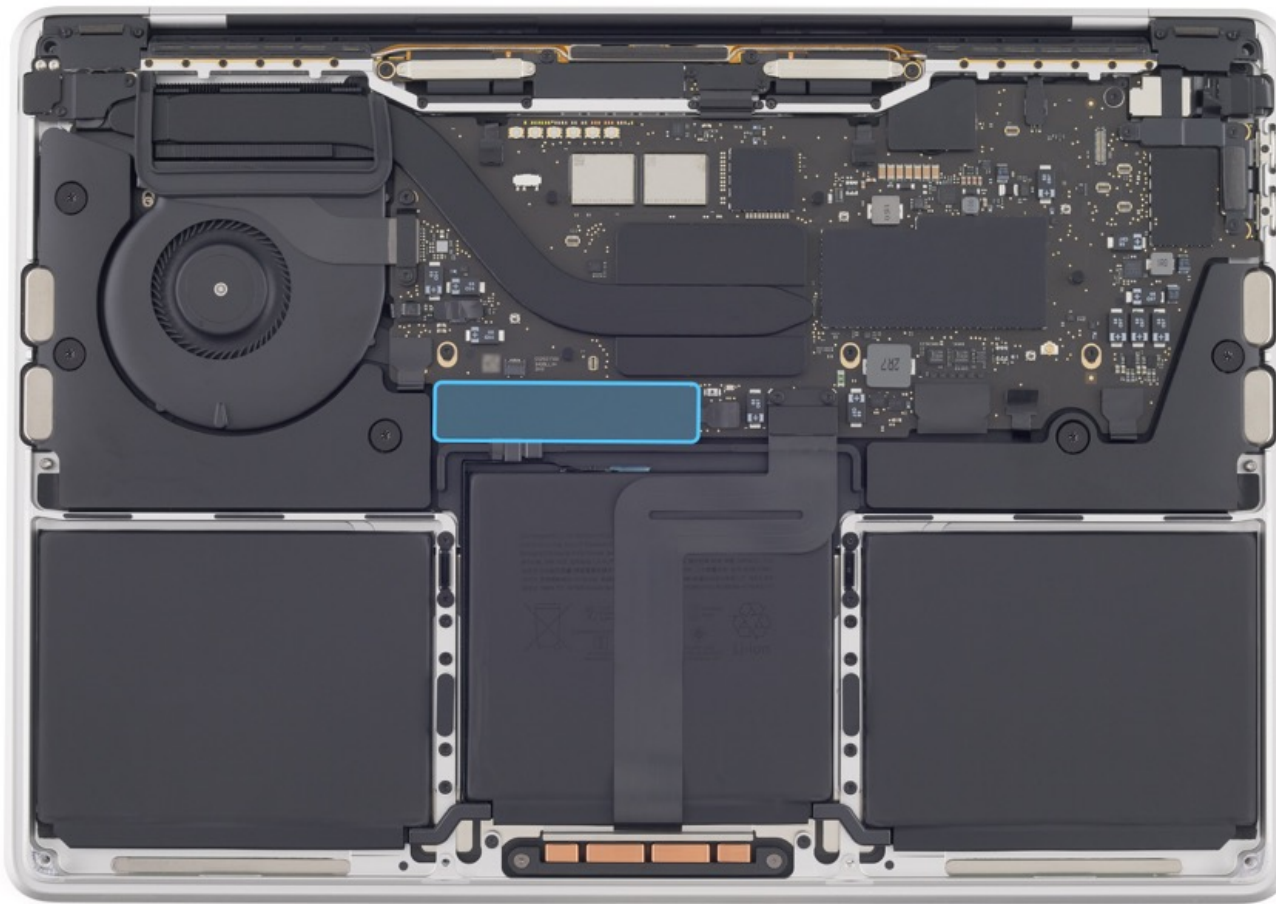
**Note:** If installing a new battery flex cable, remove the blue adhesive backing from the pull tab before adhering the pull tab to the locking lever connector.



3. Remove the battery cover and reinstall the BMU Mylar cover.

**Important:** Some replacement parts include a new BMU Mylar cover. Always install a new BMU Mylar cover if one is provided.





4. Reinstall the [bottom case](#).

**Important:**

5. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# MacBook Pro (13-inch, M1, 2020) Battery Management Unit (BMU) Flex Cable

## First Steps

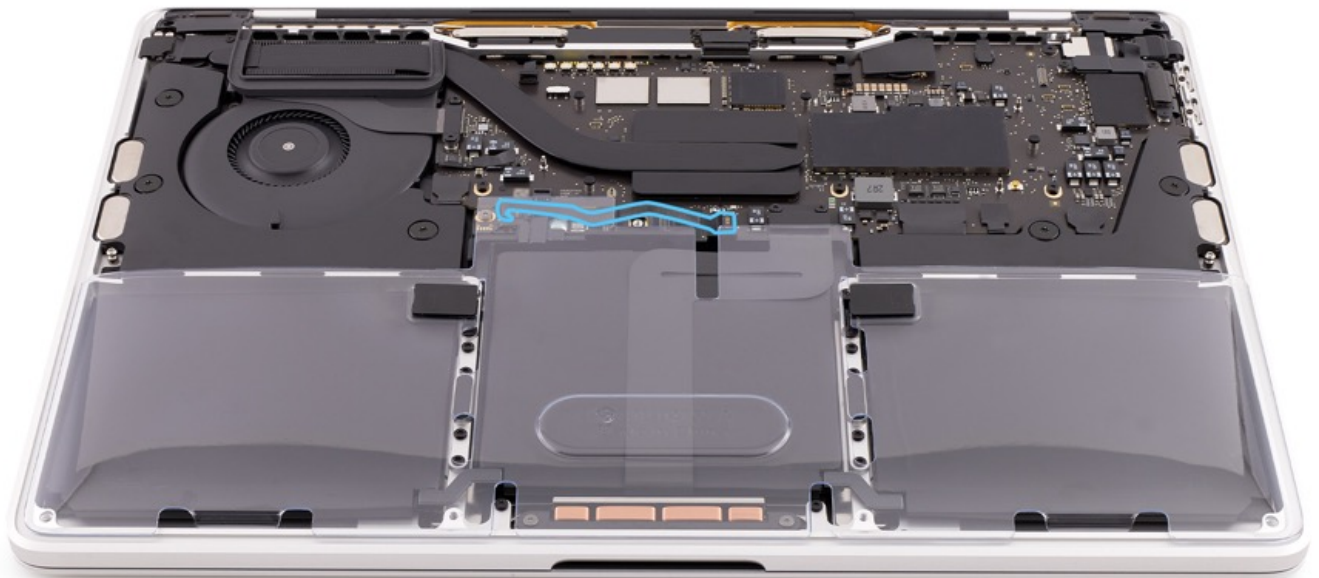


### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)



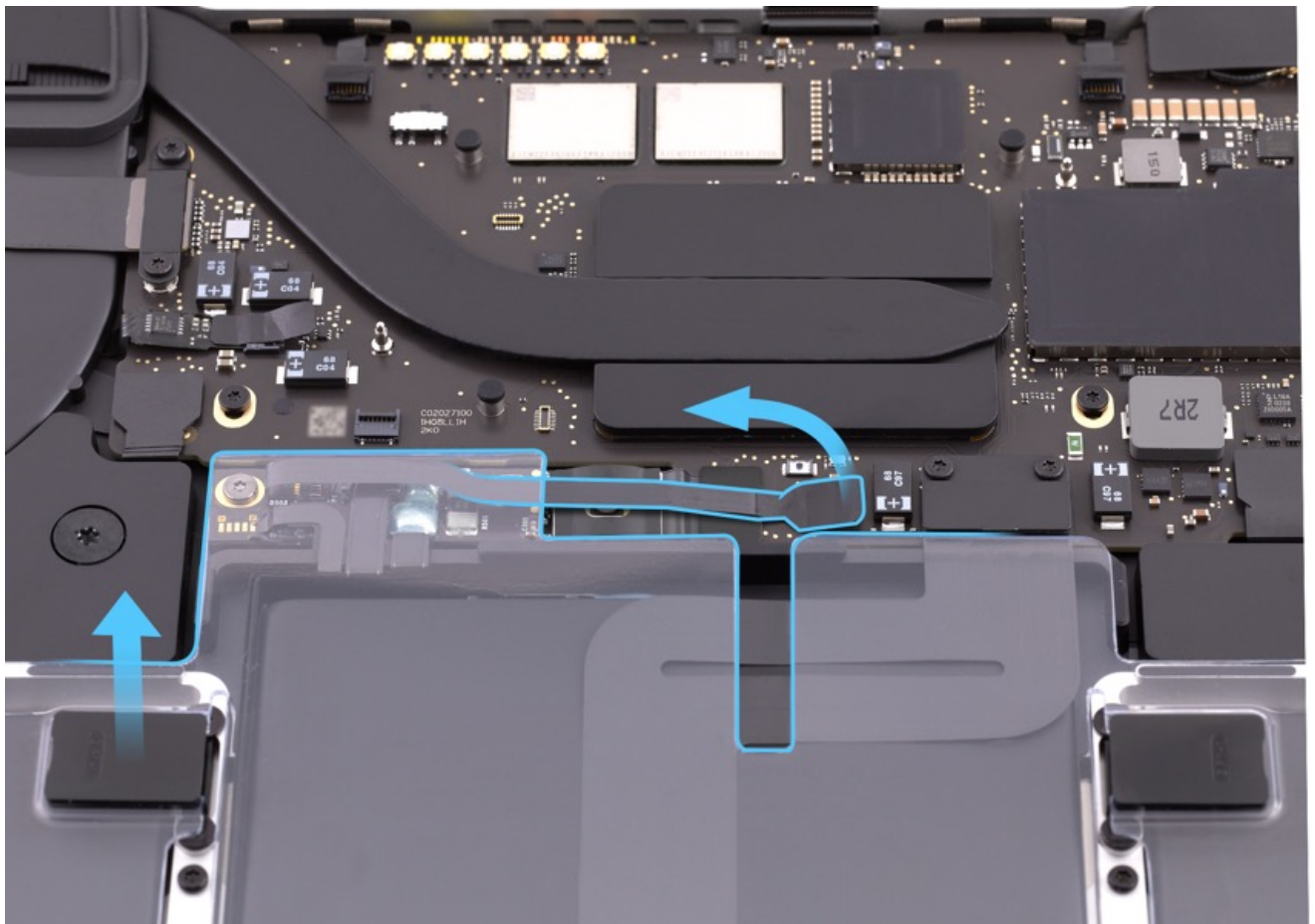
## Tools

1. ESD wrist strap
2. Black stick
3. ESD-safe tweezers

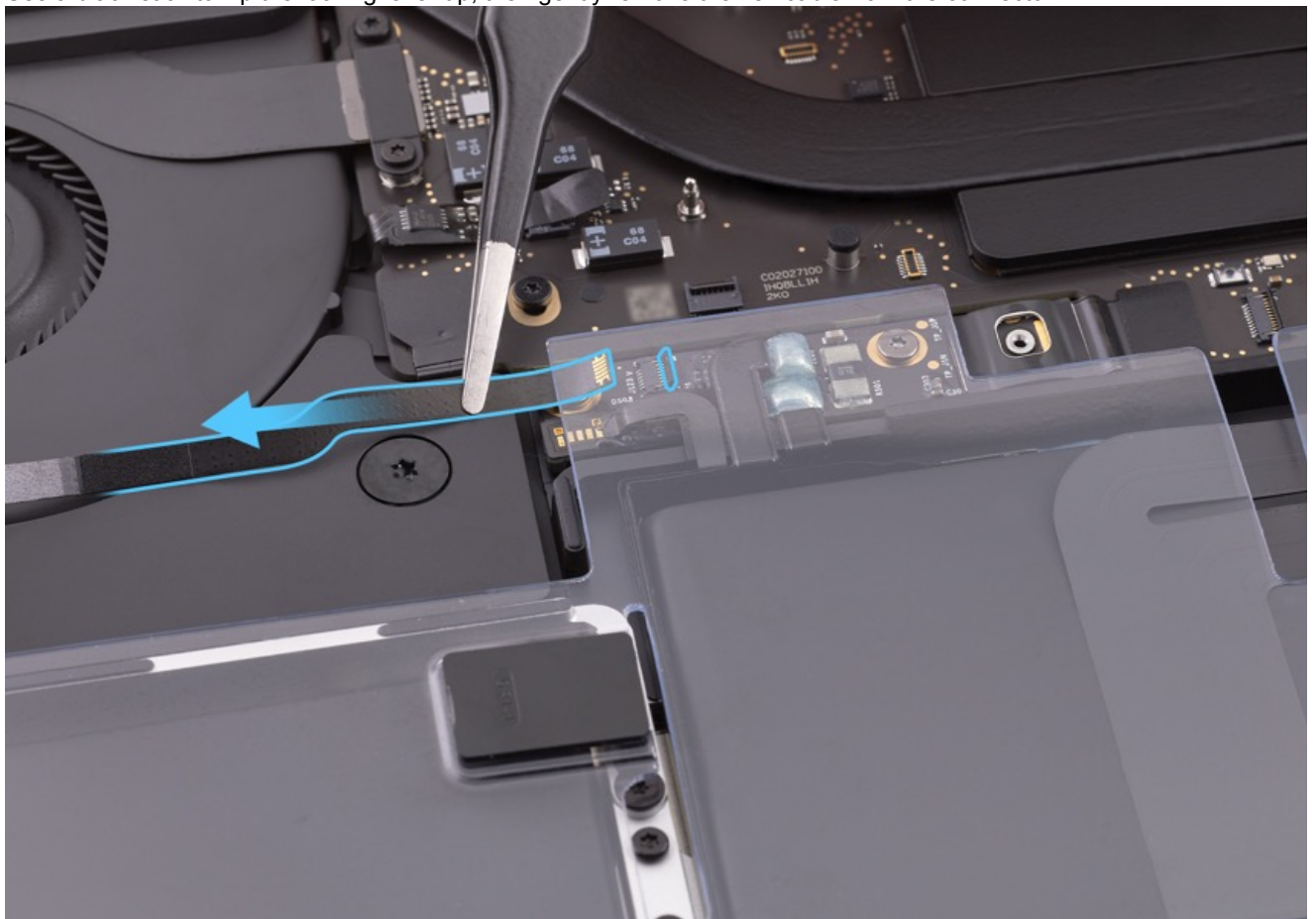


## Steps For Removal

1. To access the locking lever connector on the battery management unit (BMU) board, slightly lift the battery cover and unfold the BMU flex cable toward the fan. Tuck the BMU flex cable under the battery cover.



2. Use a black stick to flip the locking lever up, then gently remove the flex cable from the connector.



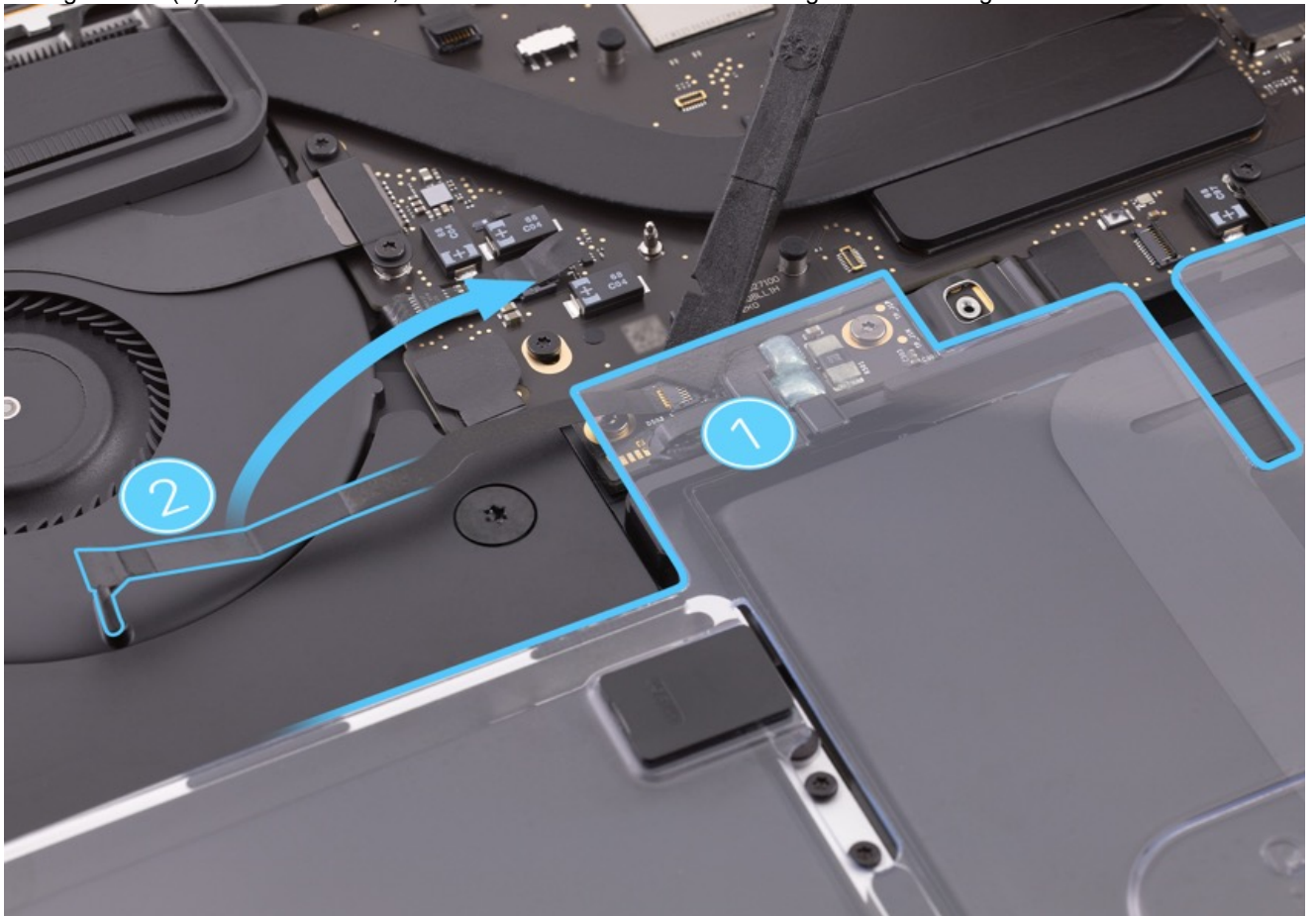
## Steps For Reassembly

1. Reinstall the narrow end of the BMU flex cable into the locking lever connector on the BMU board.





2. Use a black stick to close the locking lever (1), then slightly lift the battery cover and fold the BMU cable back toward the logic board (2). Once connected, use the black stick to close the locking lever on the logic board.



3. [Reconnect the battery and remove the battery cover.](#)
4. Reinstall the [bottom case](#).

**Important:**

5. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# MacBook Pro (13-inch, M1, 2020) Logic Board

## First Steps



### Caution:

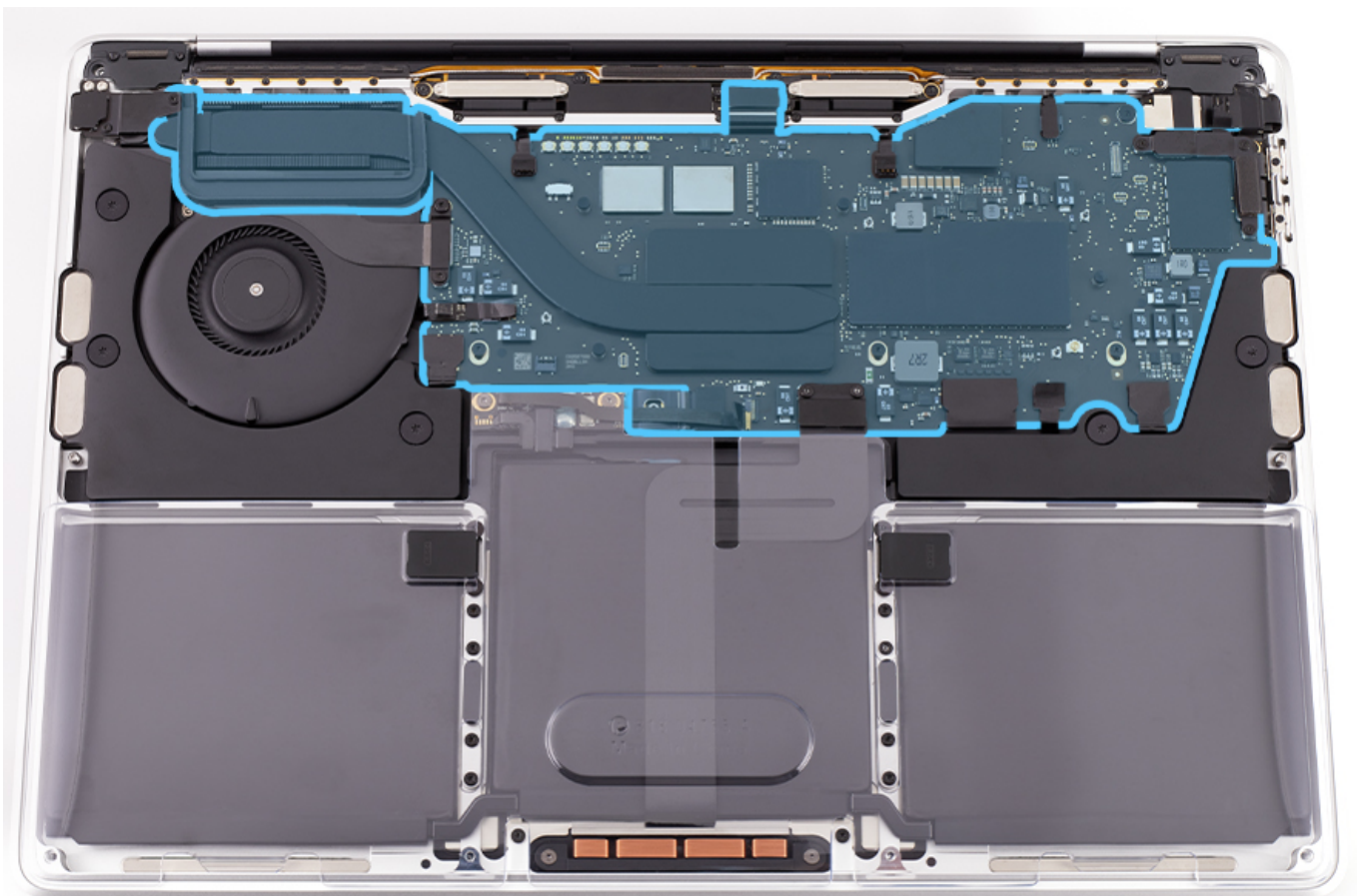
- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, you must [attach the battery cover and disconnect the battery](#) (RP1693). Wait one minute for the logic board to discharge before proceeding.
- Don't connect the computer to any external power source during repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### System Configuration:

- **Important:** Completing the [System Configuration suite](#) (TP1901) is required for the [display](#), [logic board](#), [top case](#), and [Touch ID board](#) procedures. Run the System Configuration suite to configure the replacement part with the computer.
- If you replace the logic board, you **must also** replace the [Touch ID board](#). But if you reinstall the same logic board, you don't need to replace the Touch ID board.

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)



## Tools

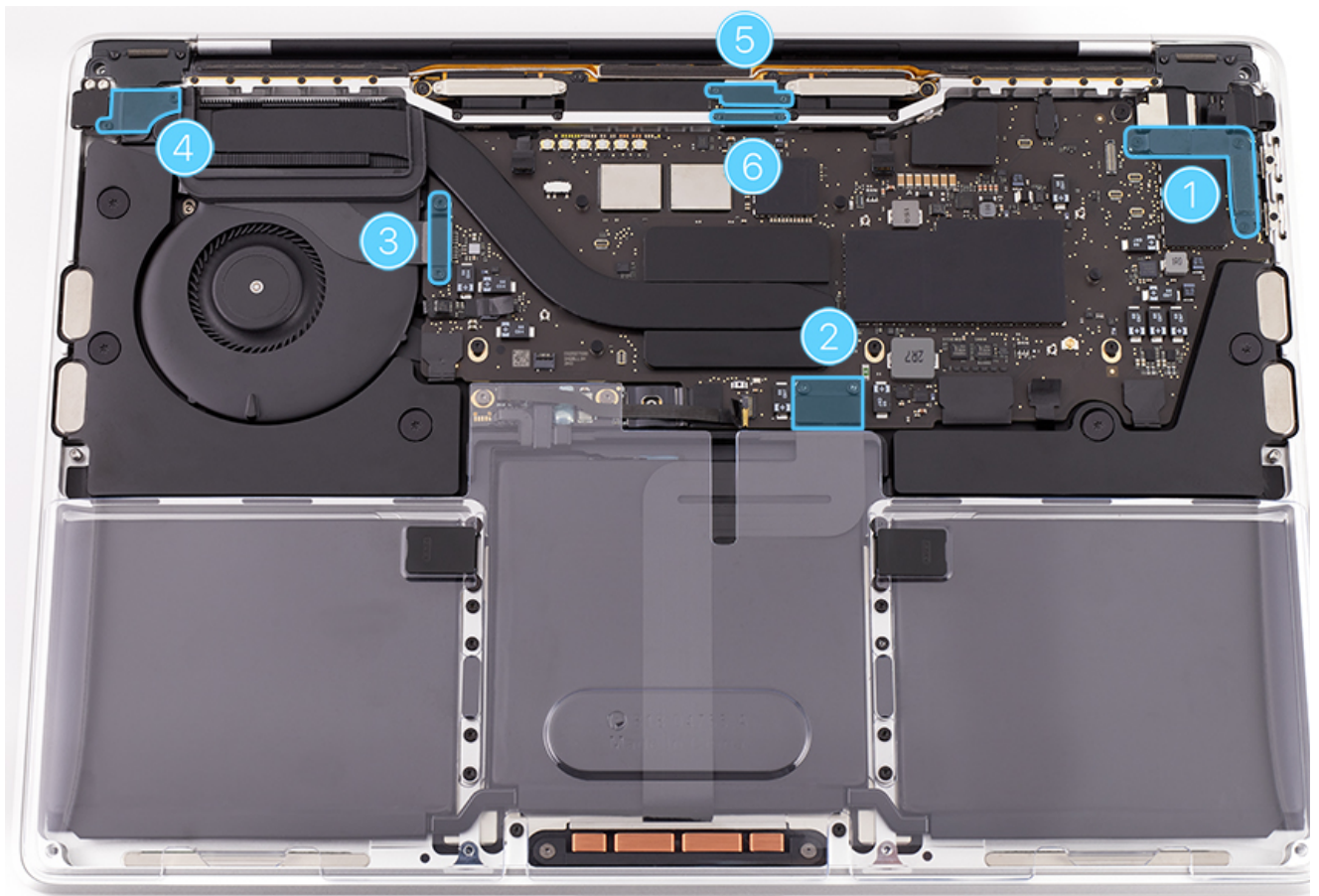


1. Antenna tool (923-01322)
2. Black stick
3. ESD-safe tweezers
4. Torx T3 screwdriver
5. Torx T5 screwdriver
6. 3 mm hex nut driver



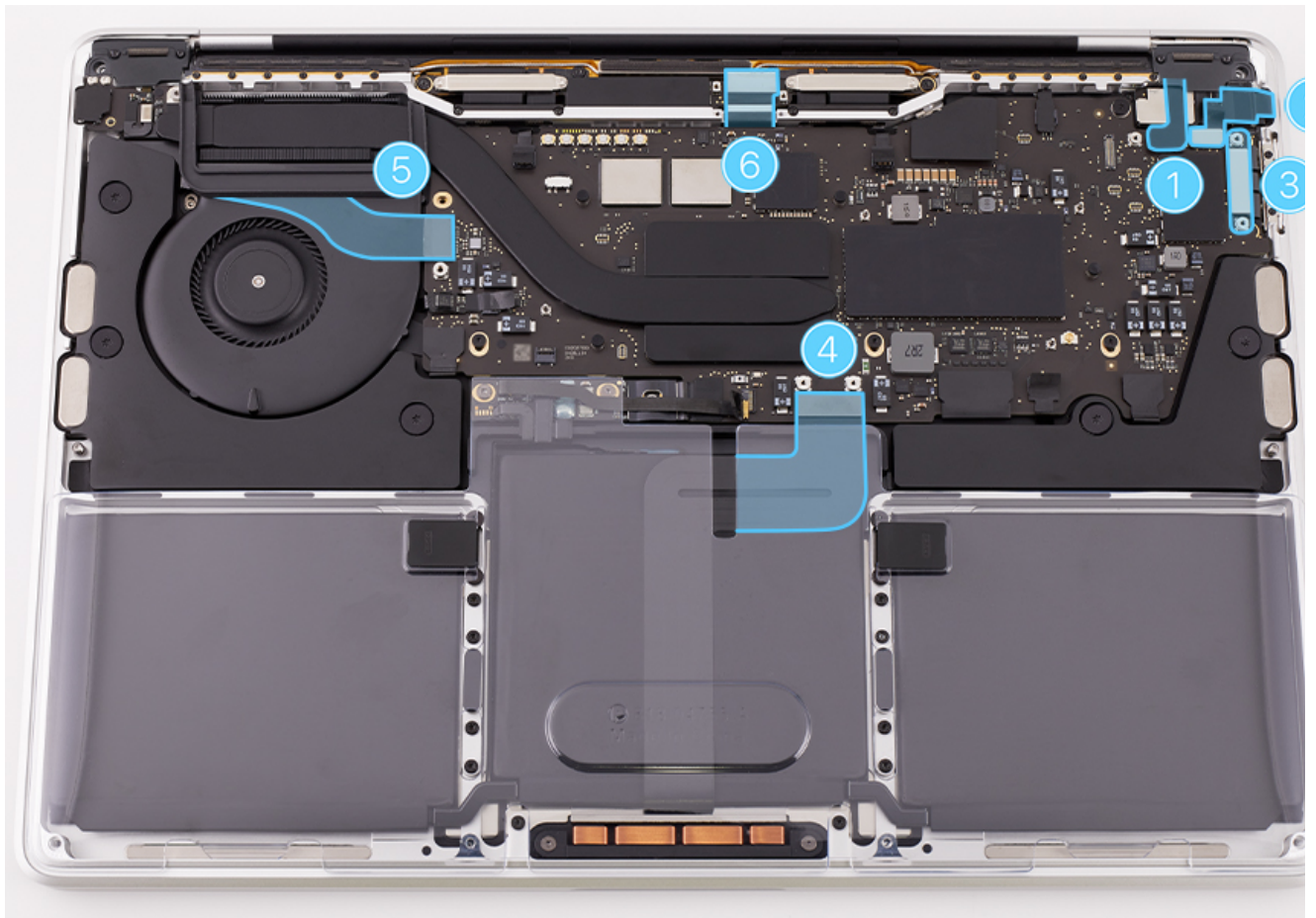
## Steps For Removal

1. Remove 13 screws from six cowlings. Then remove the six cowlings.
  1. Three T3 screws from the L-shaped cowing.
  2. Two T5 screws from the trackpad flex cable cowing.
  3. Two T5 screws from the audio board flex assembly cowing.
  - Important:** The audio board flex assembly cowing (3) has a deeper bend where the upper screw is located. Remember the orientation of the cowing for reinstallation.
  4. Two T3 screws from the Touch ID board cowing.
  5. Two T3 screws from the embedded DisplayPort (eDP) connector cowing.
  6. Two T3 screws from the eDP flex cable cowing.

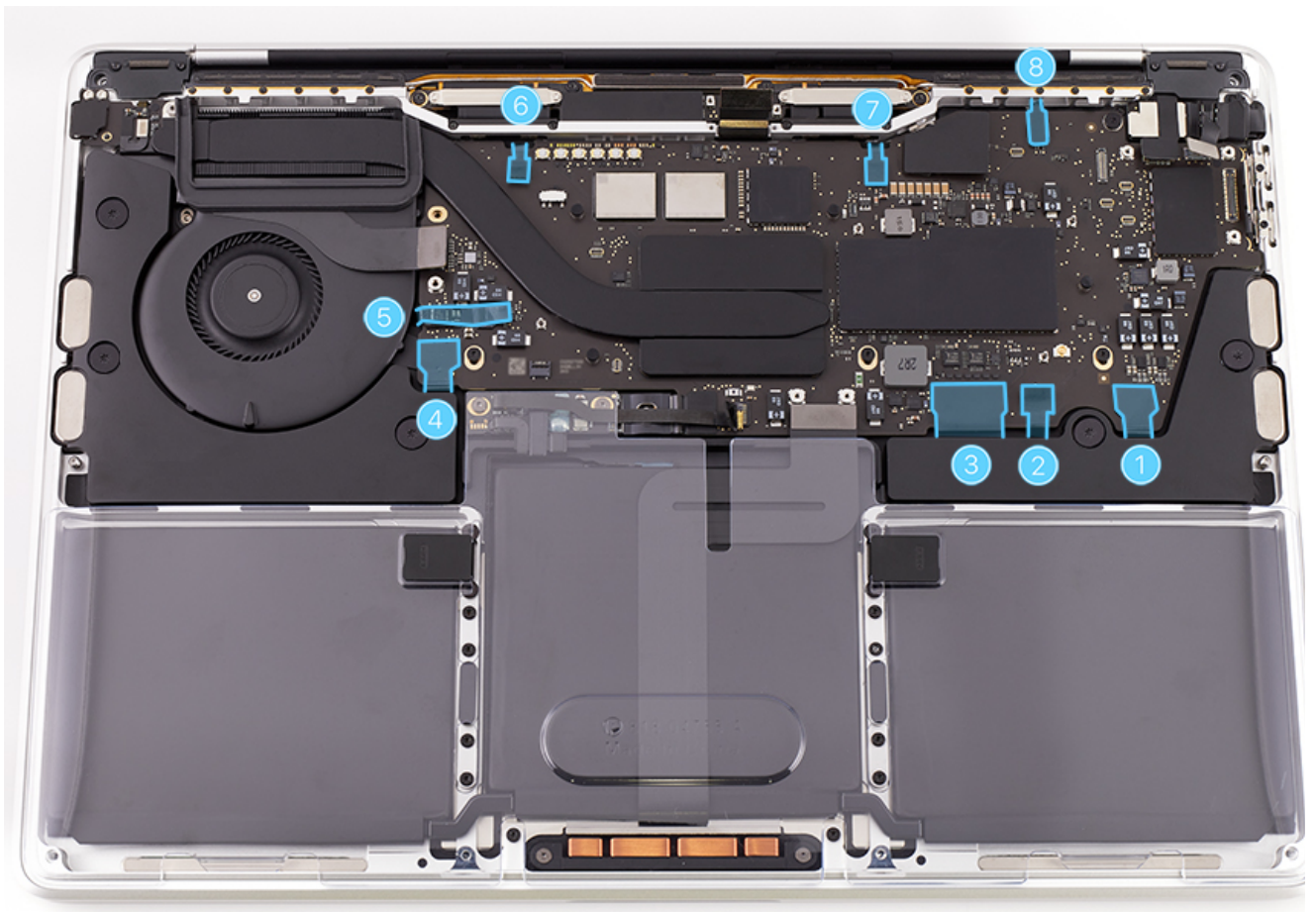


2. Disconnect five solid platform connector cables from the logic board (1-5) and one from the timing controller (TCON) board (6).
  1. Touch Bar display
  2. Touch Bar touch
  3. I/O board
  4. Trackpad
  5. Audio board flex assembly
  6. eDP

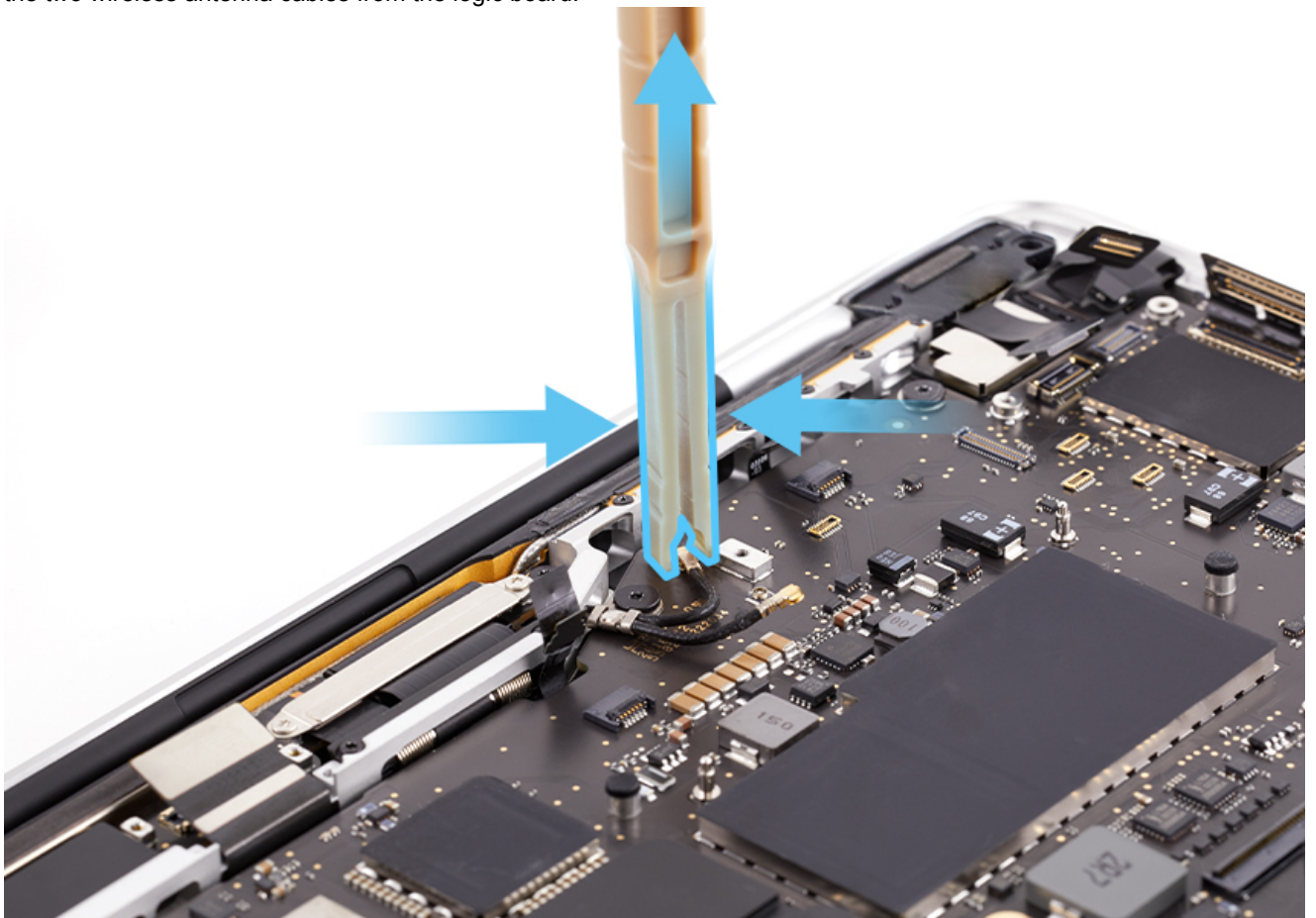




3. Carefully lift the pull tabs on the eight flex cables to reveal the locking lever connectors on the logic board. Use a black stick to lift the locking levers up. Then use the pull tabs to remove the eight flex cables from their connectors.
  1. Left speaker
  2. Keyboard backlight (power)
  3. Keyboard
  4. Right speaker
  5. Fan
  6. Keyboard backlight (right)
  7. Keyboard backlight (left)
  8. Microphone

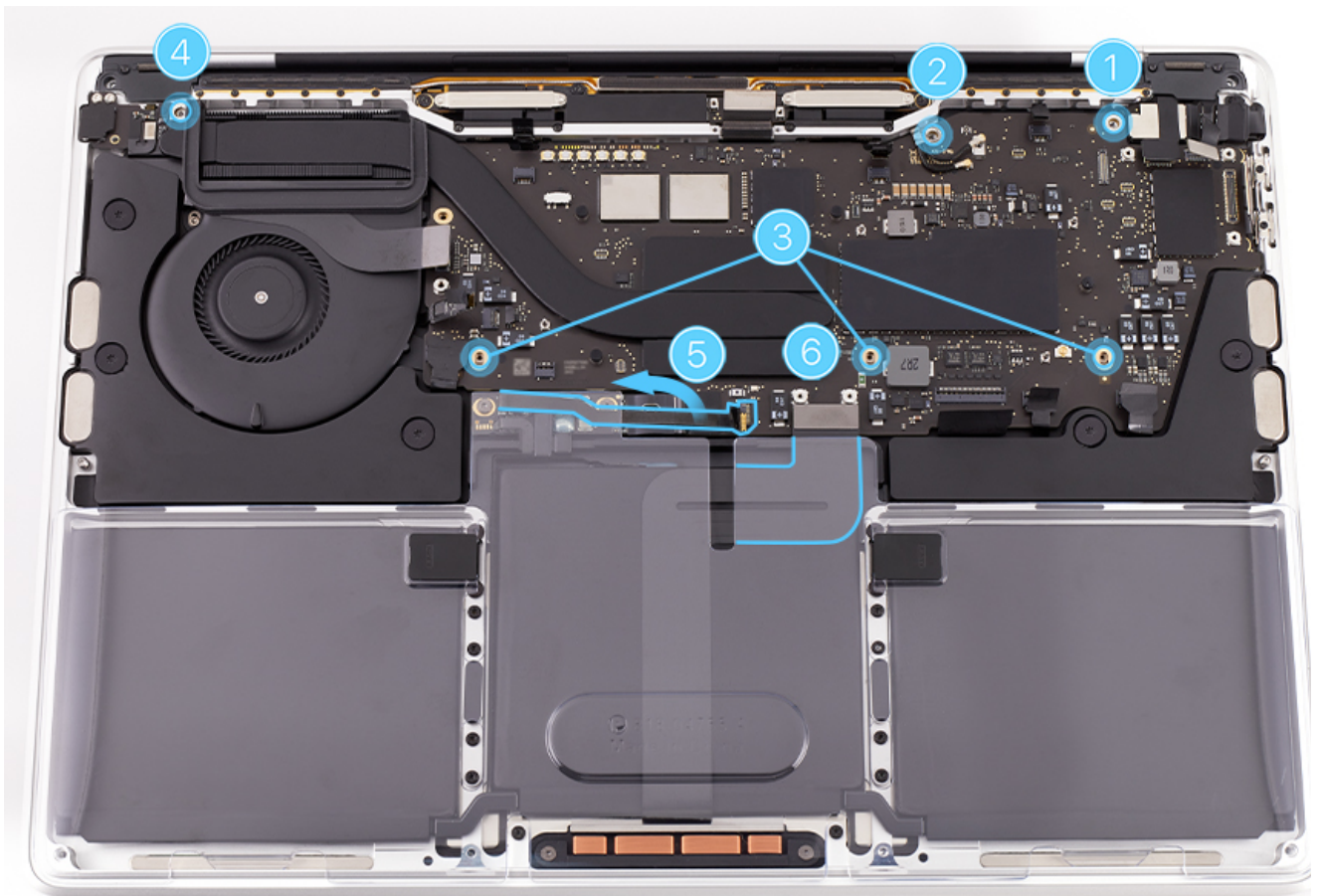


4. Remove and discard the Mylar cover located above the wireless antenna cables. Use the antenna tool to disconnect the two wireless antenna cables from the logic board.



5. Remove five T5 screws from the logic board (1, 2, 3) and one 3 mm hex screw (4) from the heat sink arm. Slightly lift the top edge of the battery cover and unfold the BMU flex cable toward the fan (5). Then, thread the trackpad flex cable through the slot in the battery cover (6). Ensure that the battery cover is fully reinstalled before continuing.



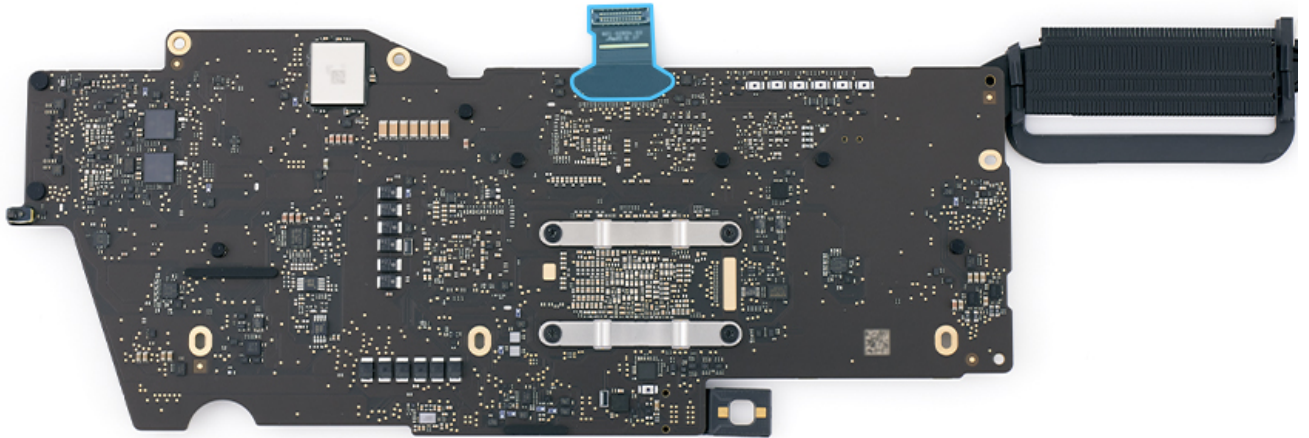


6. Slowly lift up the bottom edge of the logic board, then carefully pull the logic board toward you and out of the top case. Move cables out of the way as you remove the logic board.

**Caution:** The heat sink stays attached to the logic board. To preserve its shape and protect the fragile fins, hold the edges of the logic board, not the heat sink.



7. If you replace the logic board, remove and transfer the [eDP flex cable](#) (RP1696) to the new logic board.  
**Important:** Always apply a new Mylar cover to the eDP cowling if one is provided with the replacement part.



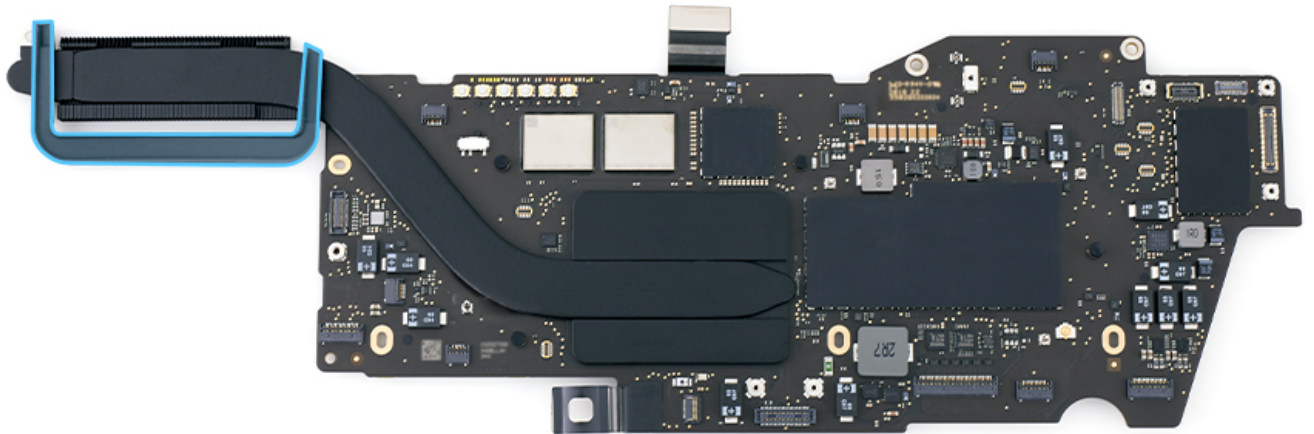
8. **Important:** Do not remove the heat sink. A replacement logic board comes with the heat sink installed.

### Steps For Reassembly

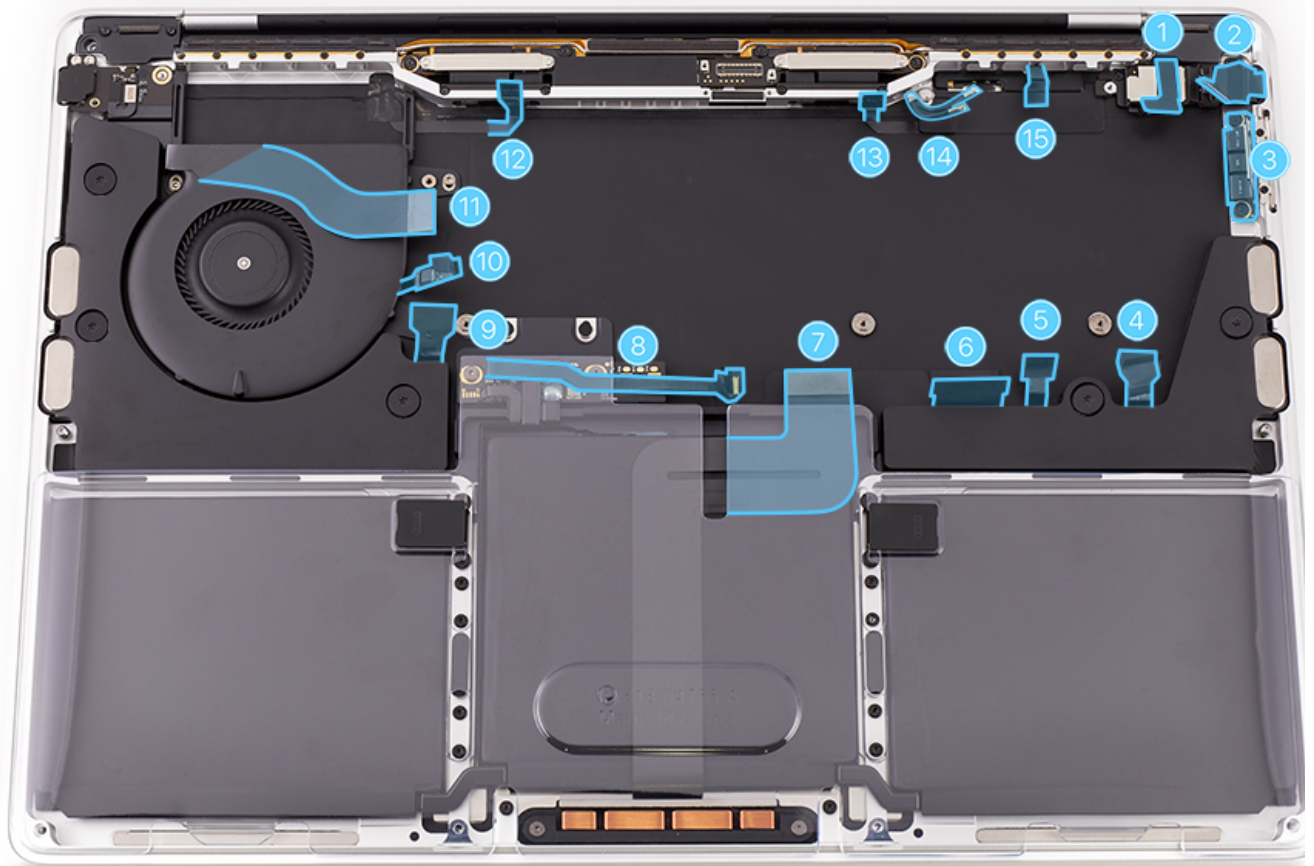


**Important:** If you are installing a replacement logic board, you must also replace the [Touch ID Board](#) .

1. Verify that the thermal duct is installed on the heat sink arm.



2. With the logic board still removed, identify all 15 cables in the top case.

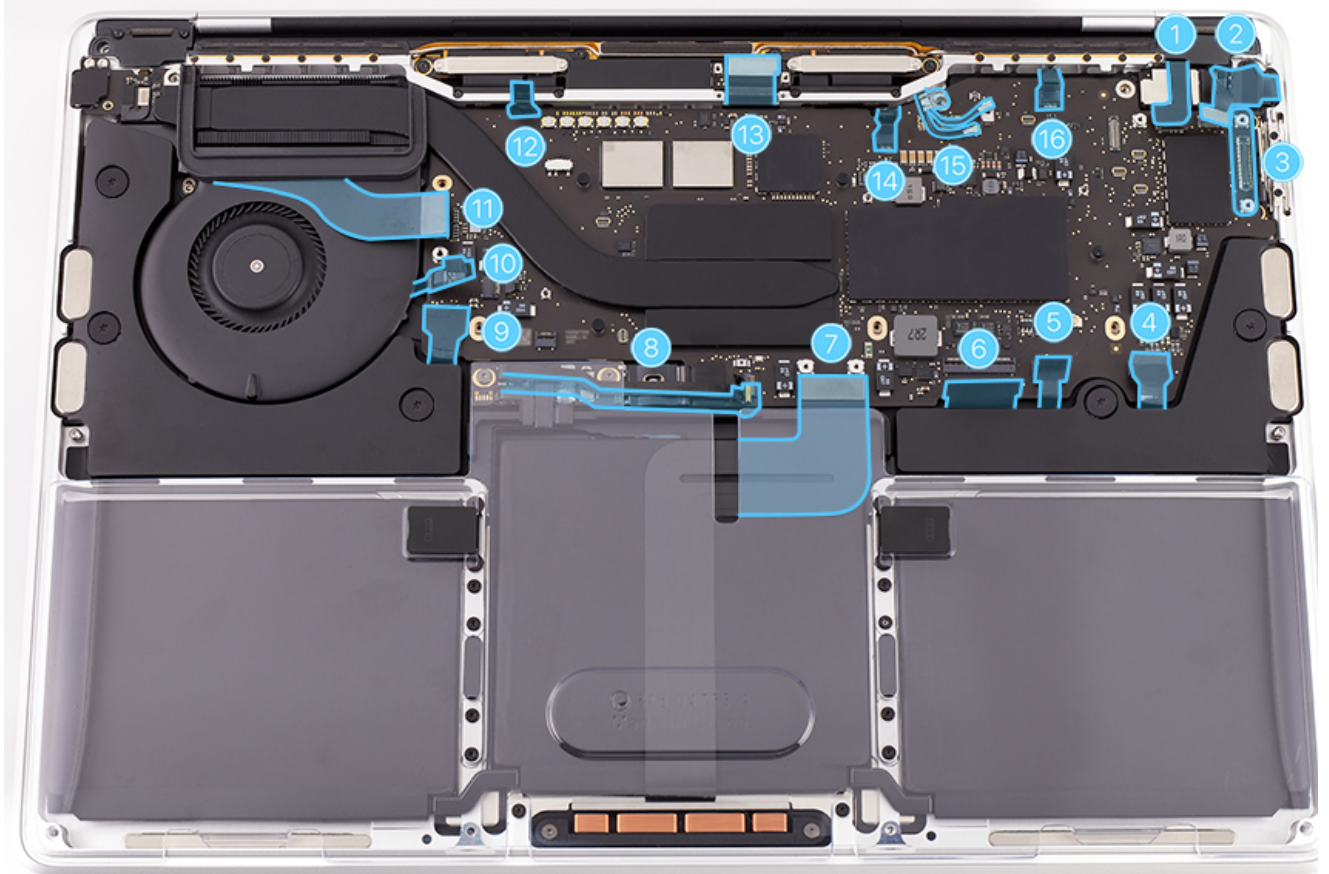


3. Lower the top edge of the logic board into the top case. Move cables out of the way as you lower the bottom edge of the logic board into the top case.





4. Count all 16 cables to ensure none are trapped under the logic board.  
**Note:** The eDP flex cable (#13) is attached to the logic board. The eDP flex cable isn't shown or counted in reassembly step 2.



5. Partially reinstall five T5 screws in the logic board and one 3 mm hex screw in the heat sink arm. After all six screws have been partially reinstalled, fully tighten them.



(1) 923-05240 (2) 923-05252 (3) 923-05250 (4) 923-05247



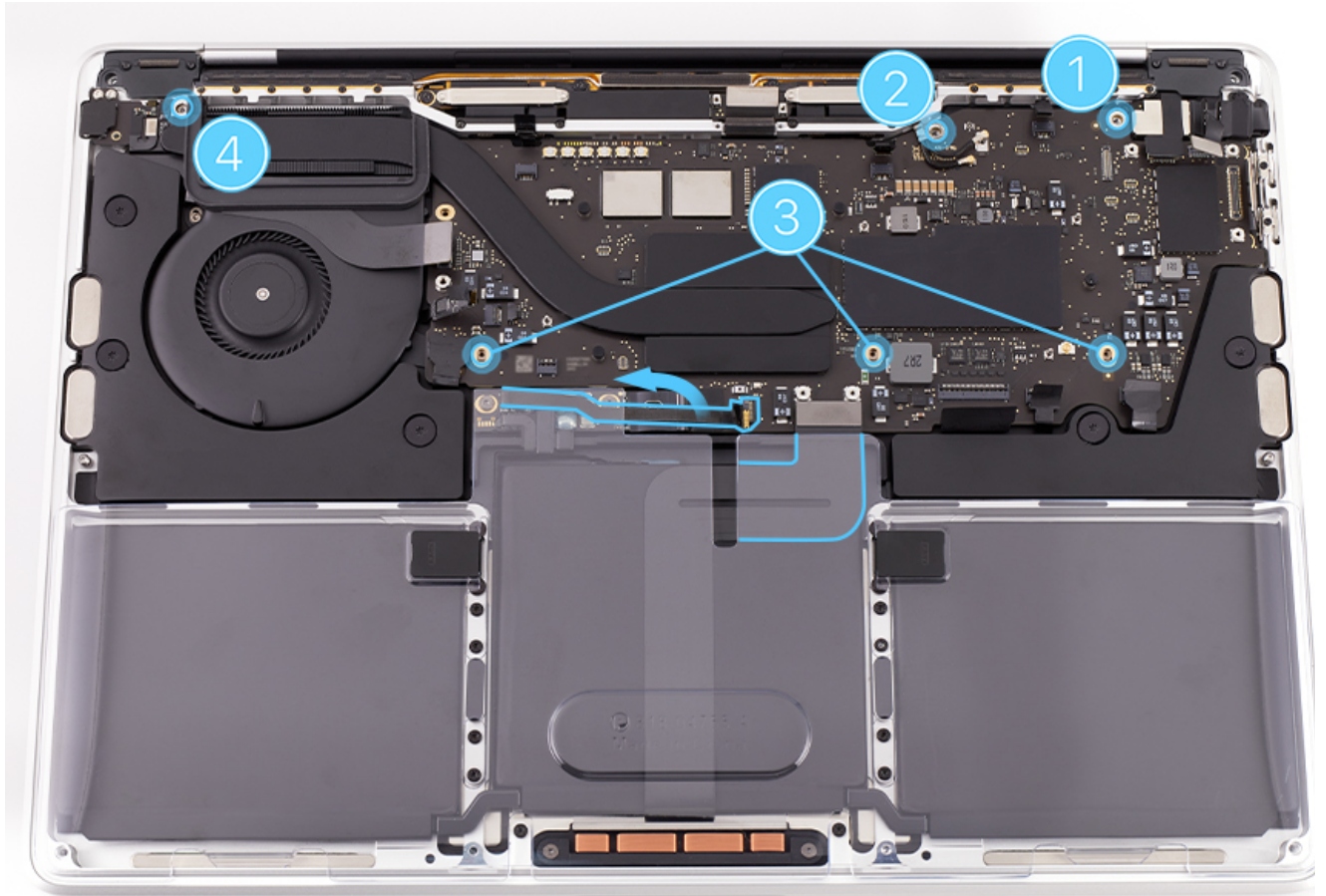
One T5 screw.



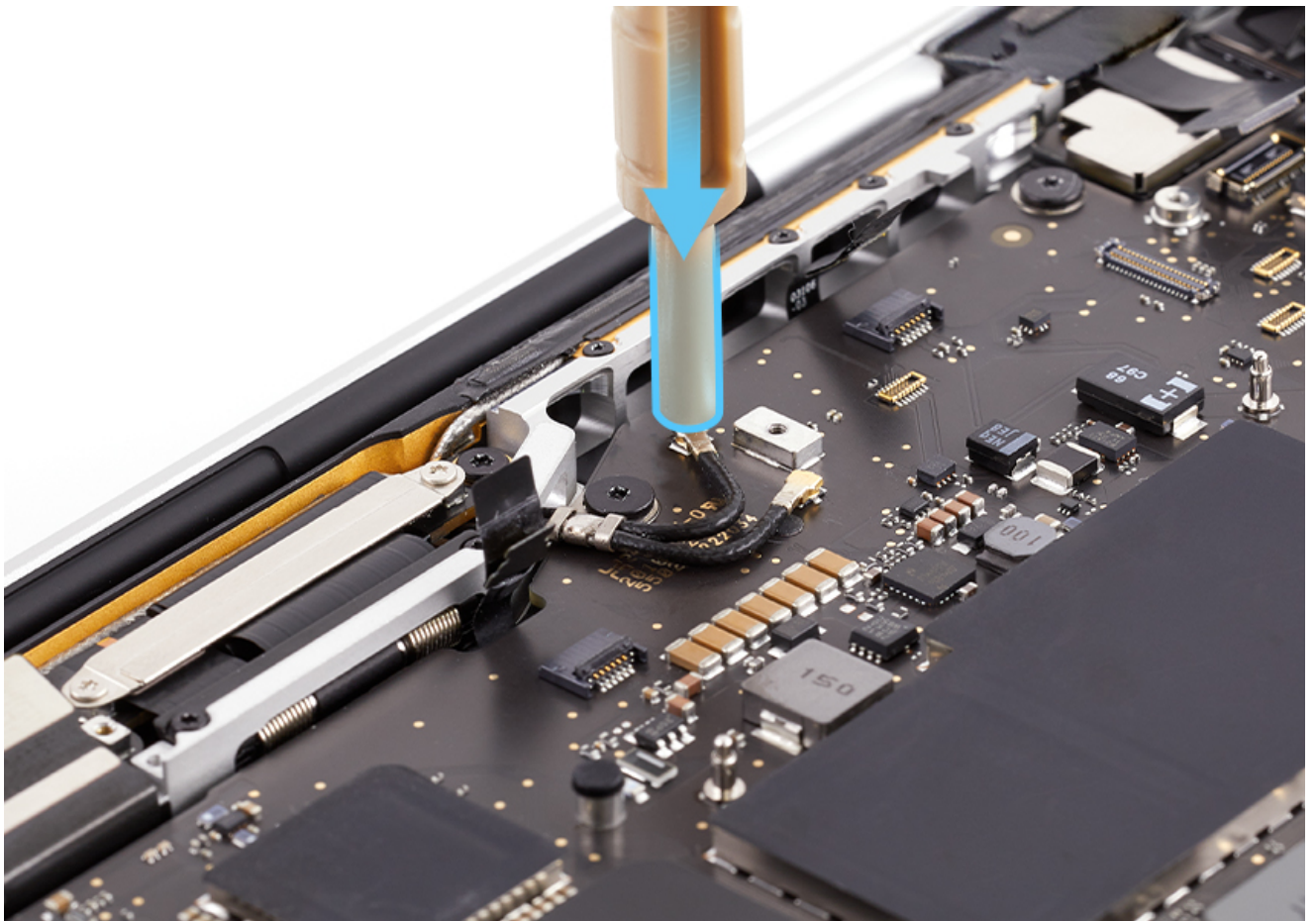
One T5 screw.



Three T5 screws. One 3 mm hex screw.



6. Use the flat end of the antenna tool to reconnect the two wireless antenna cables to the logic board.  
**Caution:** To prevent damage caused by loose debris, install a new Mylar cover (923-04328) over the wireless antennas and screw. The Mylar cover is included with service parts, but can also be ordered separately.



7. Reconnect the eight flex cables to the locking lever connectors on the logic board. Use a black stick to close the locking levers and adhere the flex cable pull tabs over each connector.

1. Left speaker
2. Keyboard backlight (power)
3. Keyboard
4. Right speaker
5. Fan
6. Keyboard backlight (right)
7. Keyboard backlight (left)
8. Microphone

8. Reconnect five platform connector cables to the logic board and one to the TCON board.

**Important:** Slightly lift the battery cover and remove the trackpad cable from the slot in the battery cover. Ensure that the battery cover is fully reinstalled before continuing.

1. Touch Bar display
2. Touch Bar touch
3. I/O board
4. Trackpad
5. Audio board flex assembly
6. eDP

9. Reinstall six cowlings, then reinstall the 13 cowling screws.

**Important:** Reinstall the audio board flex assembly cowling (3) with the deeper bend positioned in the upper screw hole, closest to the heat sink arm.

1. **923-05261:** L-shaped cowling
2. **923-05233:** Trackpad flex cable cowling
3. **923-05237:** Audio board flex assembly cowling
4. **923-05234:** Touch ID board cowling
5. **923-05262:** eDP connector cowling
6. **923-05235:** eDP flex cable cowling
7. **923-04328:** Mylar cover for antenna cables

(1) 923-05253 Three T3 screws (2) 923-05254 Two T5 screws (3) 923-05255 Upper screw hole One T5 screw (3) 923-05256 Lower screw hole One T5 screw (4) 923-05253 Upper screw hole. One T3 screw (4) 923-05263 Lower screw hole. One T3 screw (5) 923-05260 Two T3 screws (6) 923-05246 Two T3 screws

10. [Reconnect the battery and remove the battery cover.](#)

11. Reinstall the [bottom case](#).

**Important:**

12. Run the [System Configuration Suite](#) (TP1901) to configure the logic board with the computer. Completing the System Configuration suite is required for [display](#), [logic board](#), [top case](#), and [Touch ID board](#) procedures.
13. Use [Apple Configurator 2](#) (TP1954) to install the latest macOS and firmware.

14. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# MacBook Pro (13-inch, M1, 2020) Embedded DisplayPort (eDP) Flex Cable

## First Steps

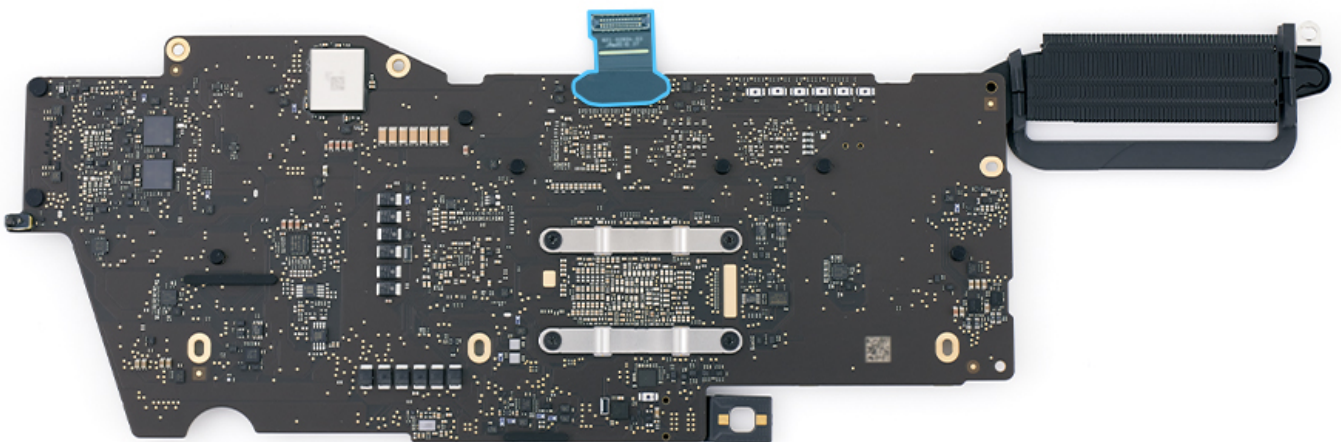


### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)
- [Logic Board](#)



## Tools

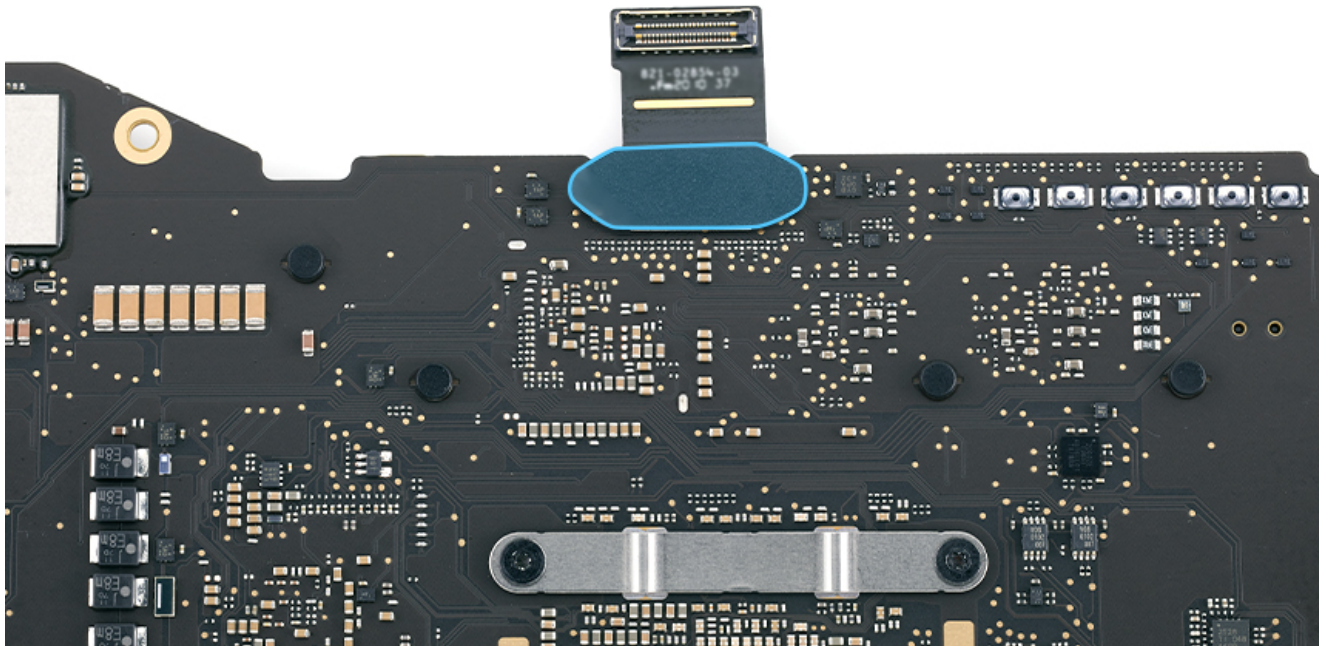
1. Torx T3 screwdriver
2. Black stick
3. ESD-safe tweezers





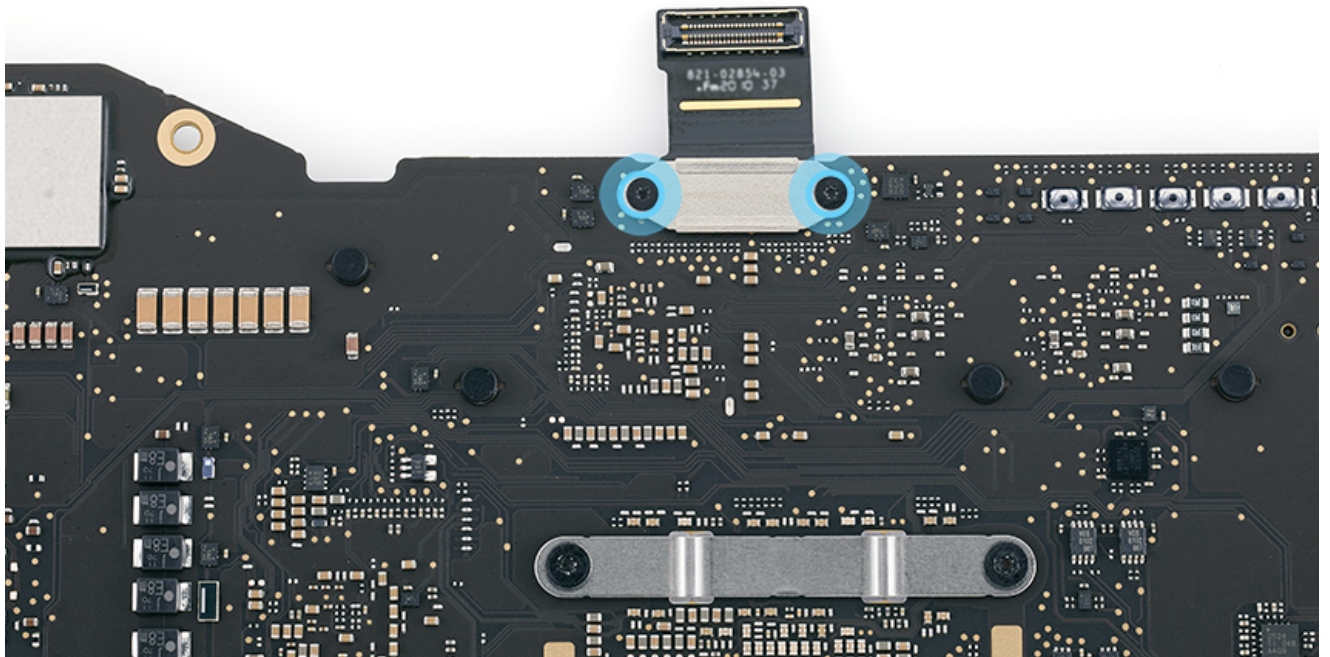
## Steps For Removal

1. Use the tweezers to peel off the Mylar tape on the right and left sides of the eDP cable to access two T3 screws



2. Remove the two T3 screws. Use the flat end of a black stick to lift up and remove the eDP cable from the logic board.

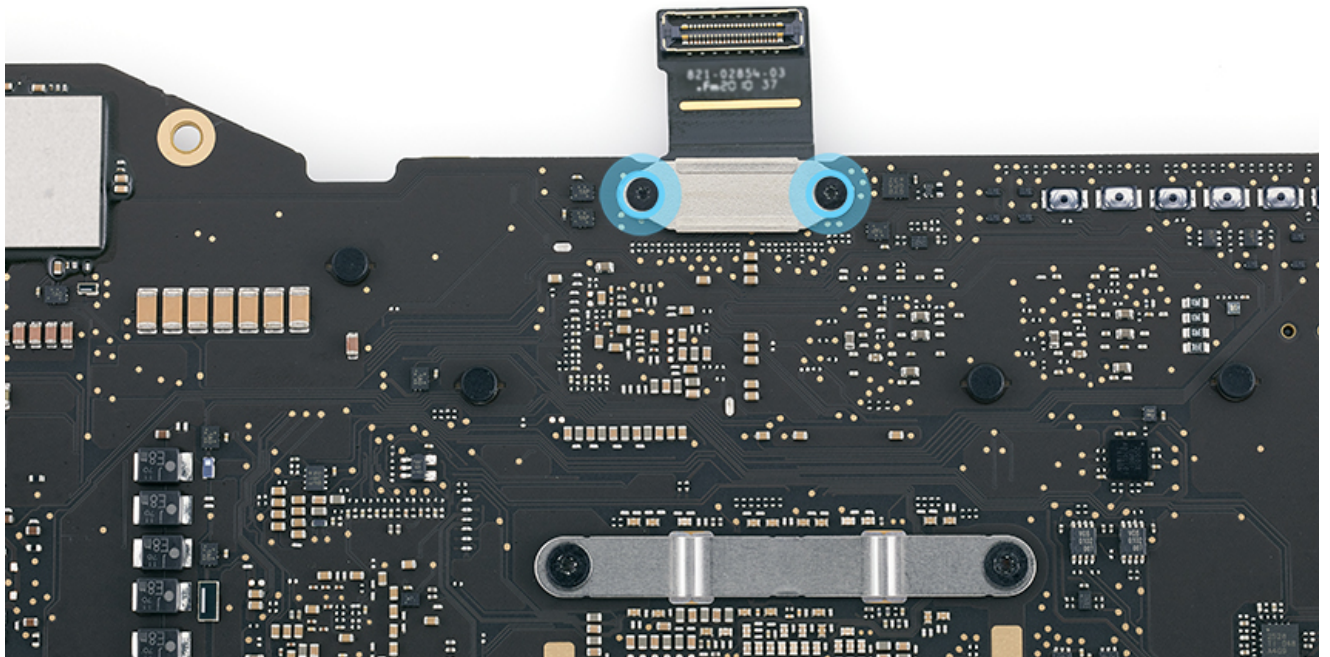




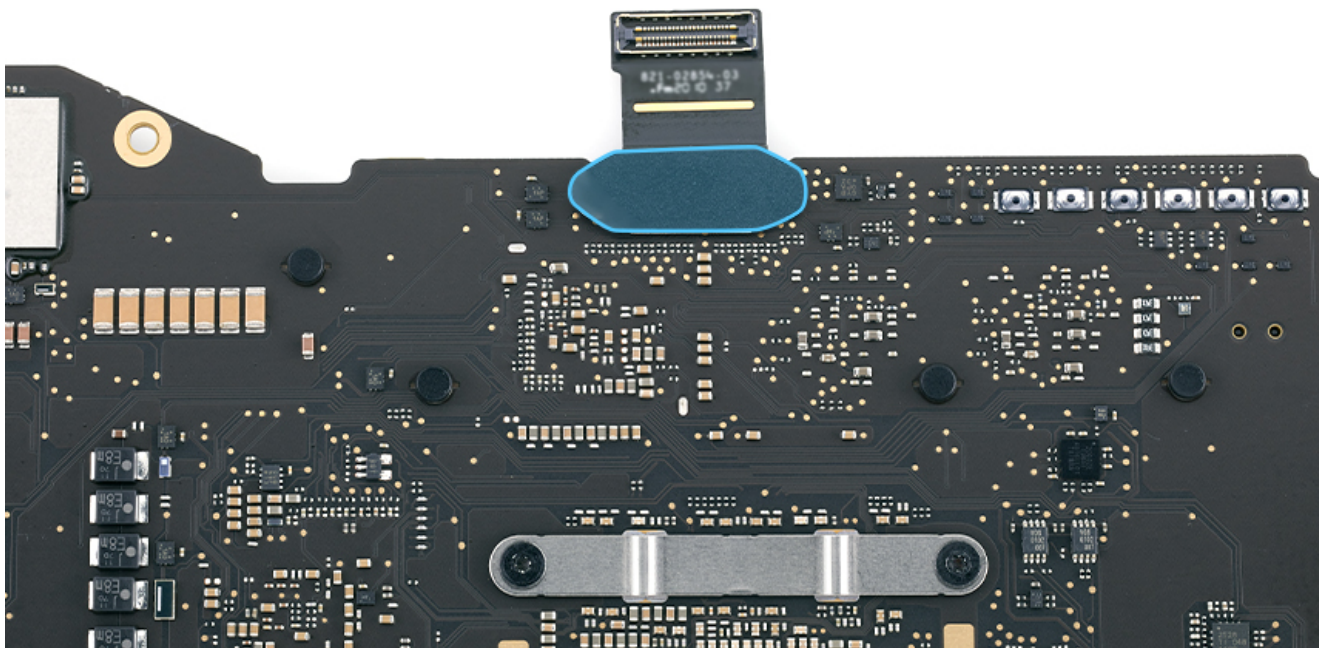
## Steps For Reassembly

1. Reinstall the two T3 screws (923-05199) to the eDP flex cable cowling.





2. Use tweezers to fasten the new Mylar tape over the eDP cable. Always use new Mylar tape if it is provided with a replacement part.



3. Reinstall the [logic board](#).
4. [Reconnect the battery and remove the battery cover](#).
5. Reinstall the [bottom case](#).

**Important:**

6. Run the appropriate [post-repair diagnostic suites](#) (TP1909).



# MacBook Pro (13-inch, M1, 2020) Input/Output (I/O) Board

## First Steps

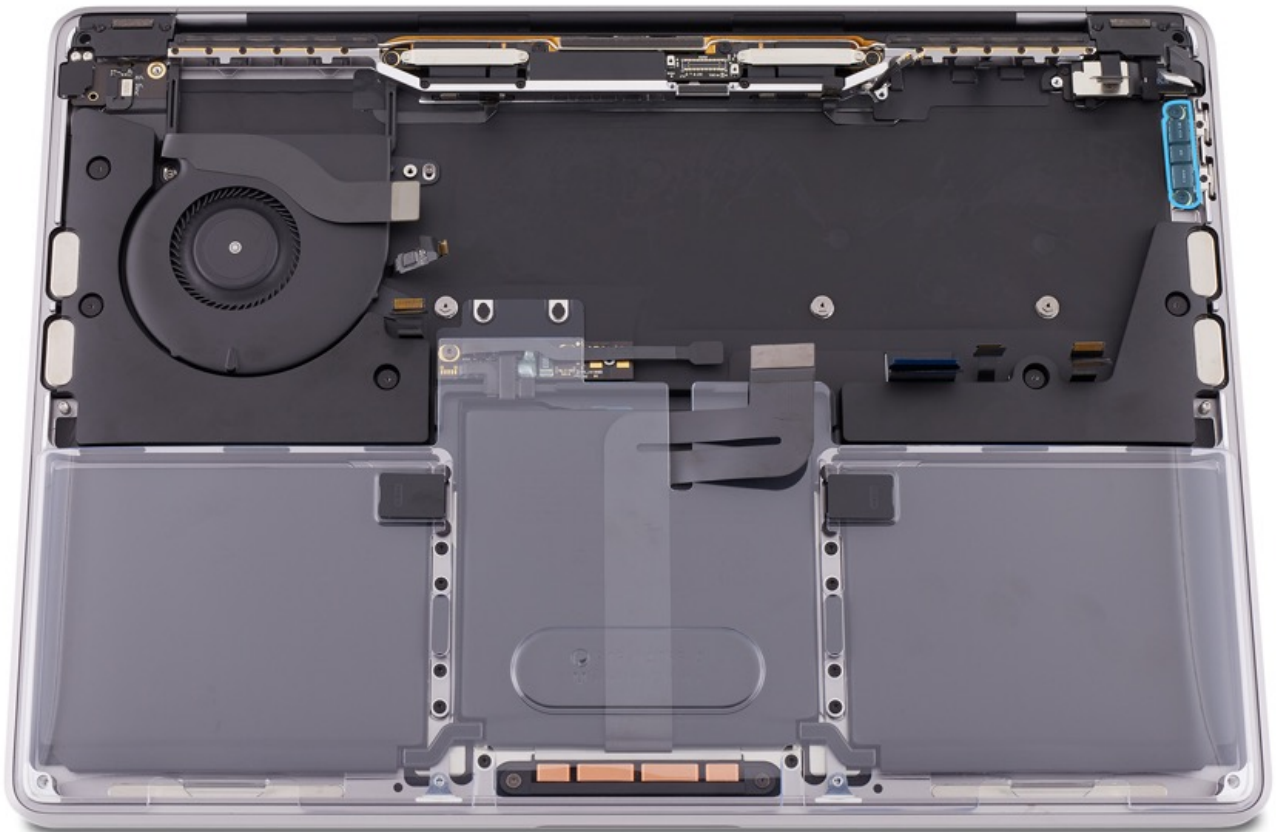


### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)
- [Logic Board](#)



## Tools

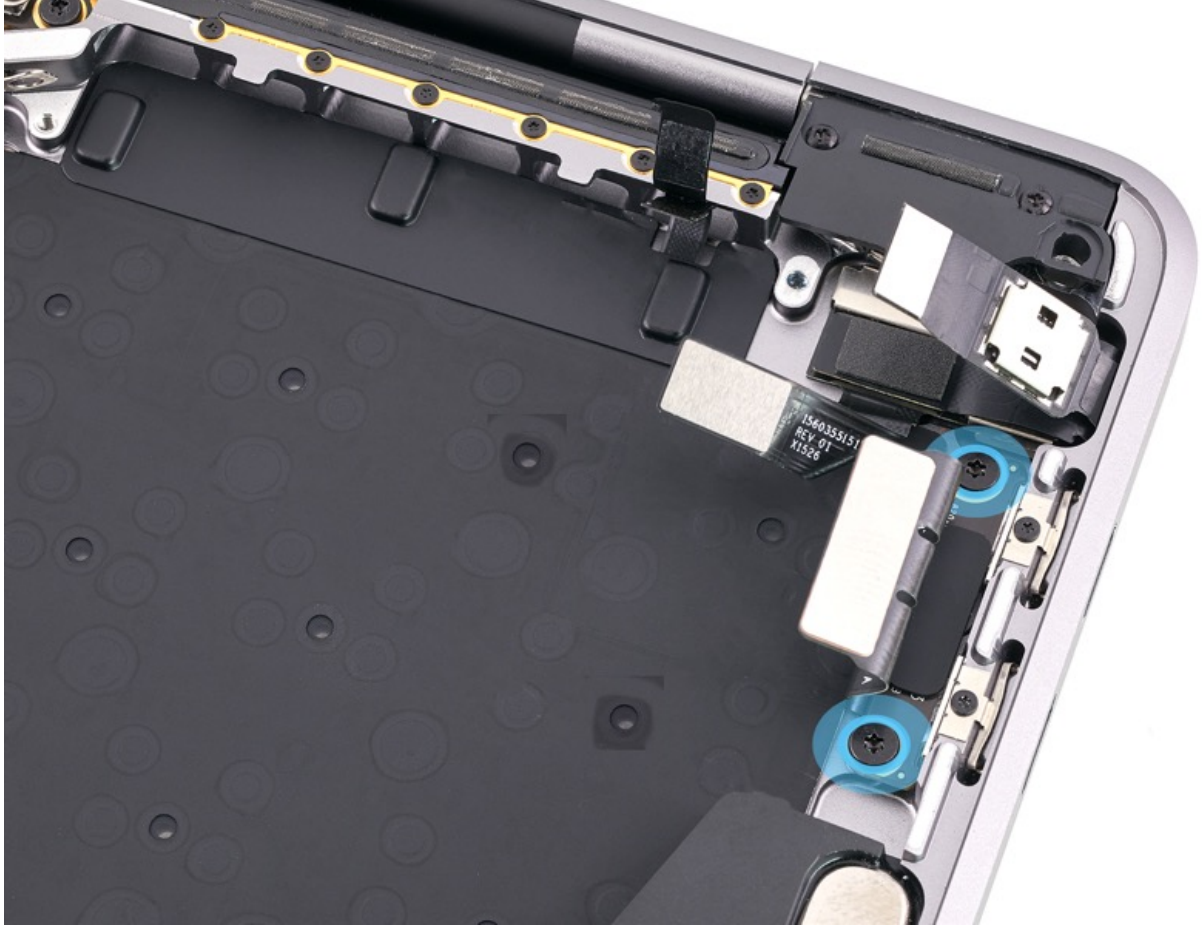
1. Black stick
2. Torx T5 screwdriver
3. USB-C charge cable





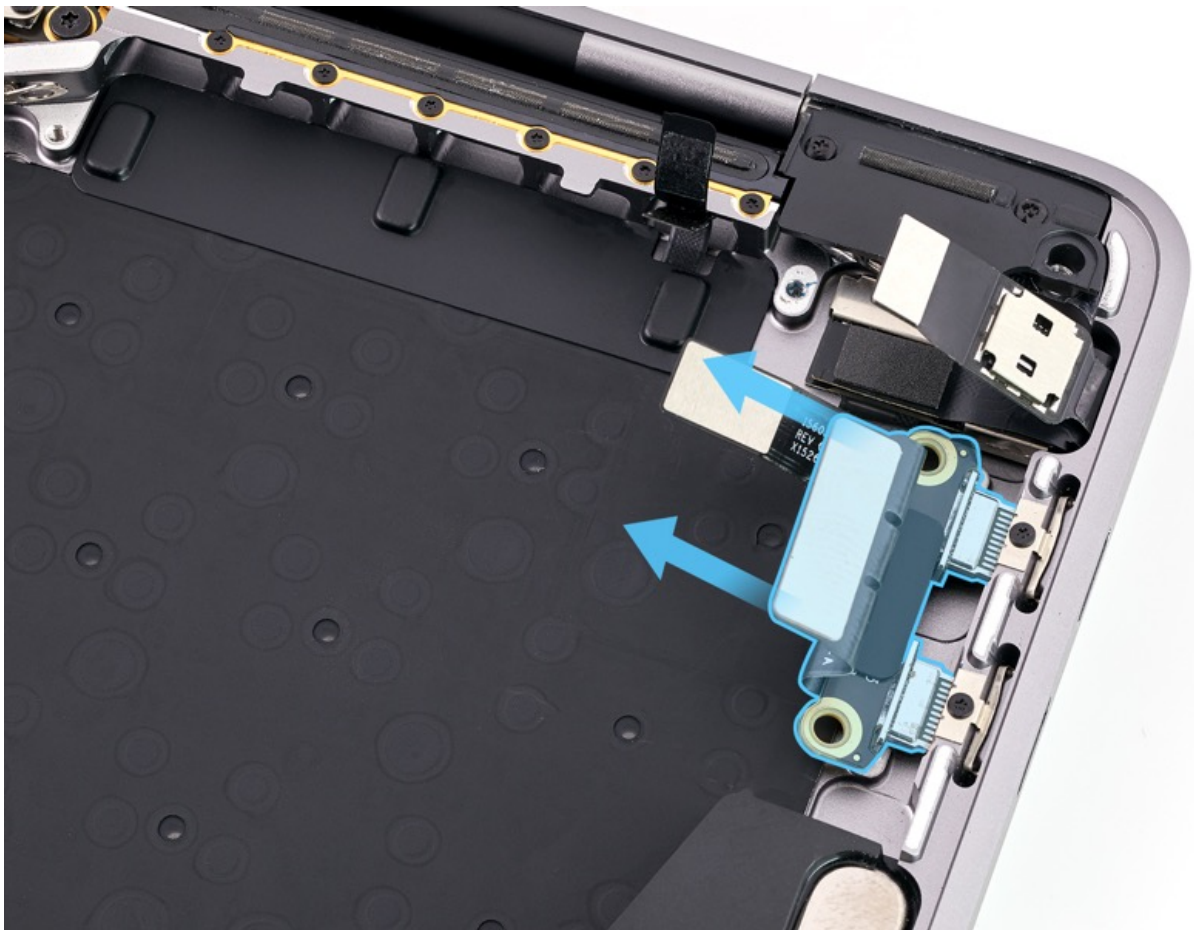
## Steps For Removal

1. Remove the two T5 screws from the I/O board.



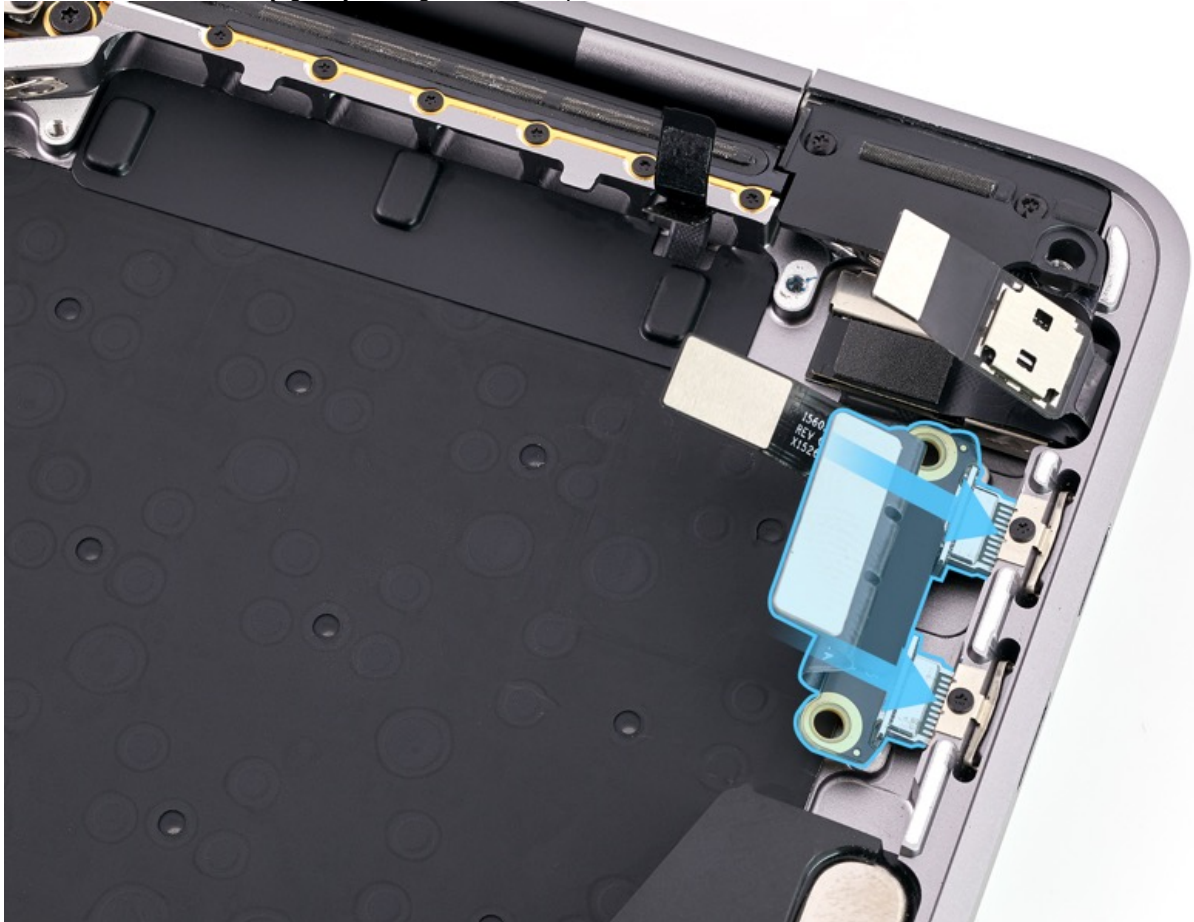
2. Gently grasp the I/O board by the sides and slide it out of the top case.





### Steps For Reassembly

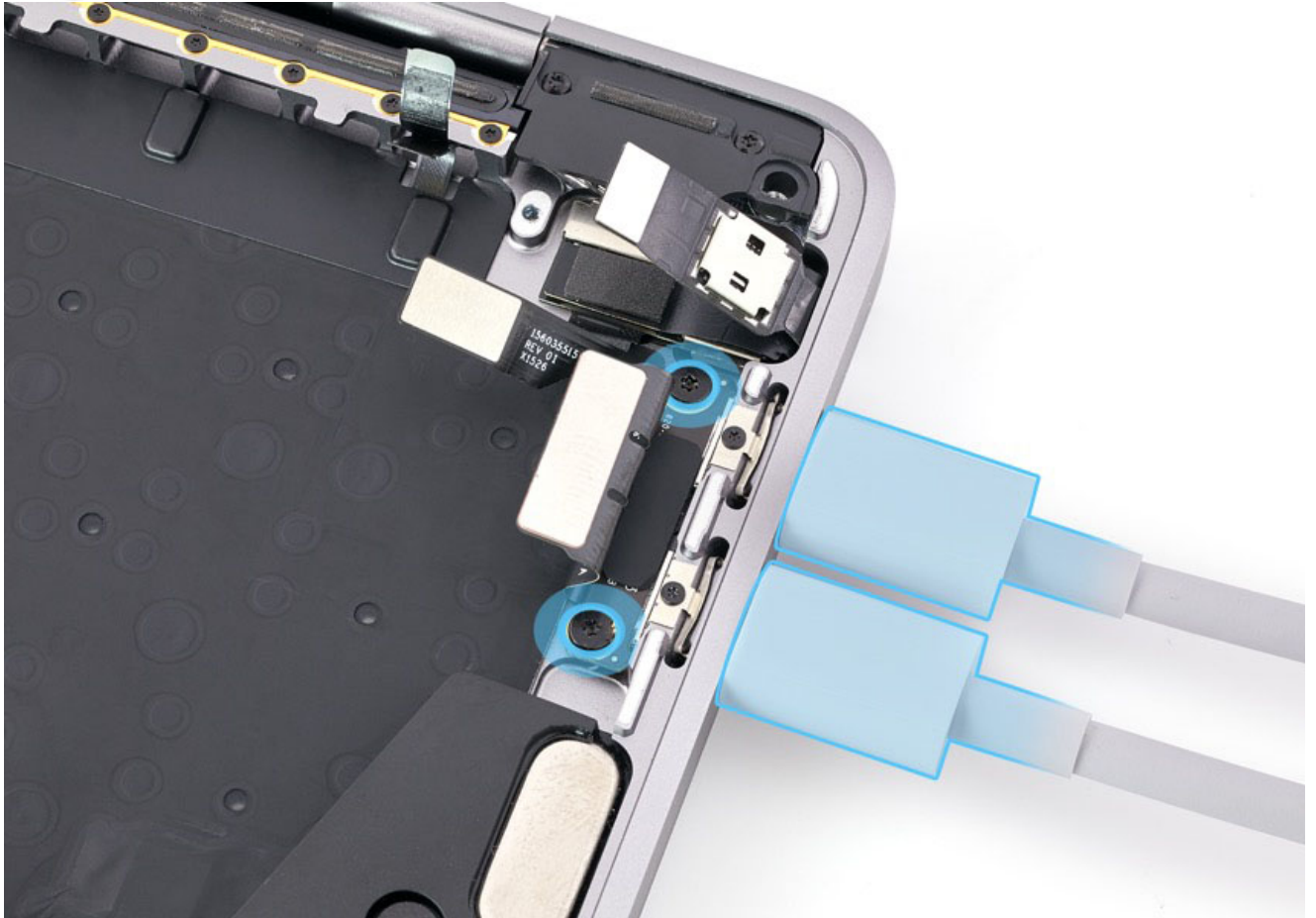
1. Reinstall the I/O board by gently sliding it into the top case.



2. Partially reinstall the two T5 screws (923-05249). Plug both ends of an external USB-C charge cable into both ports to confirm that the connectors on the I/O board align with the USB-C ports. Once confirmed, fully tighten the two T5 screws and remove the USB-C cable.



**Caution:** The charge cable should **not** be plugged into power.



3. Reinstall the [logic board](#).
4. [Reconnect the battery and remove the battery cover](#).
5. Reinstall the [bottom case](#).

**Important:**

6. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# MacBook Pro (13-inch, M1, 2020) Speakers

## First Steps

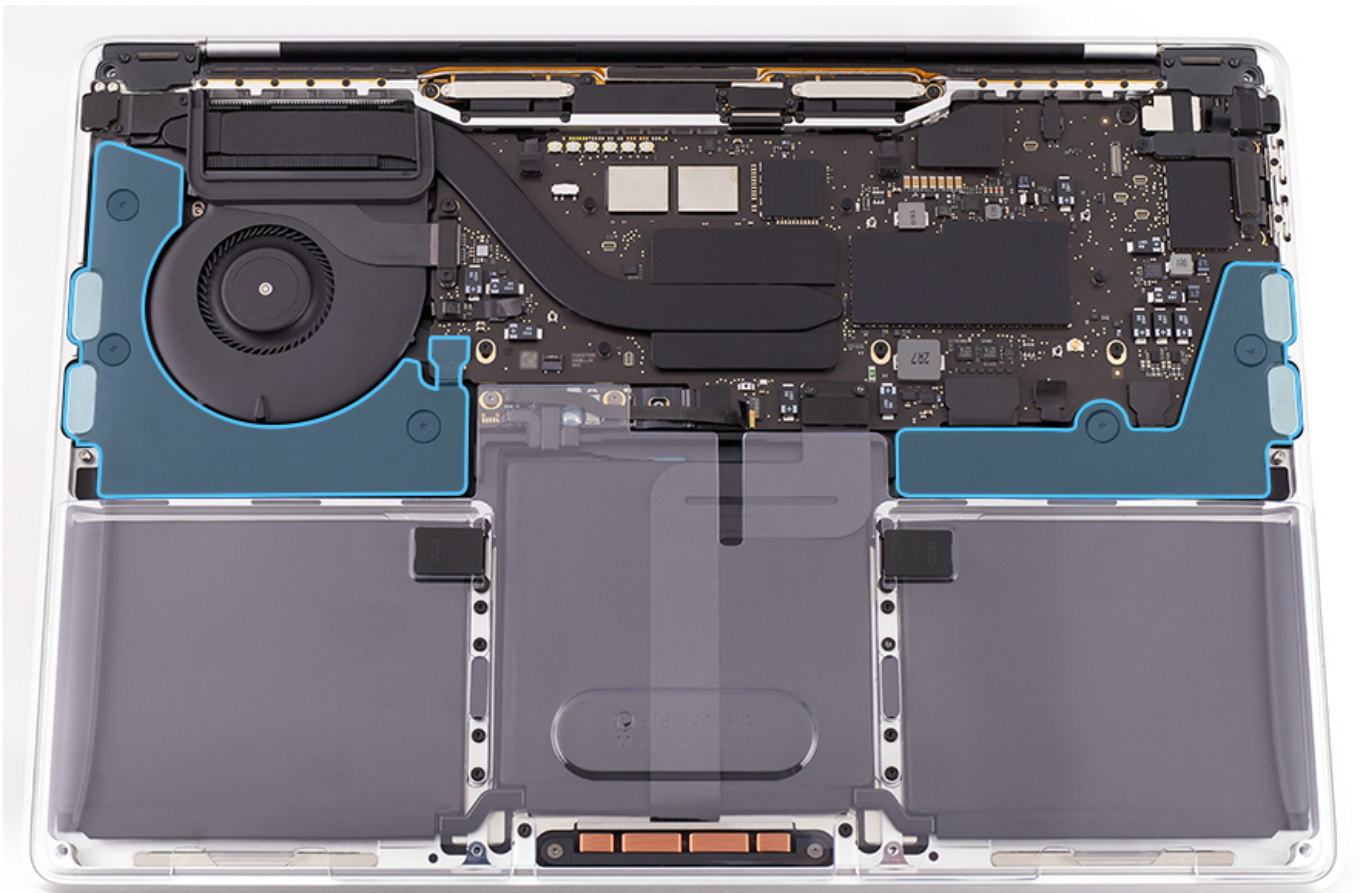


### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)



## Tools

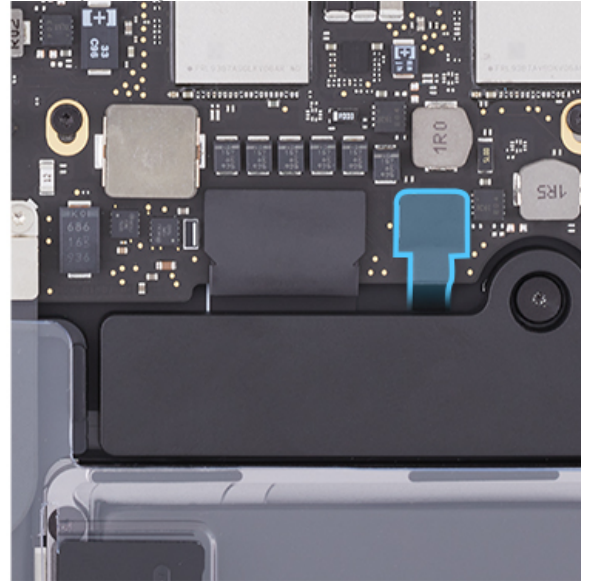
1. Torx T5 screwdriver
2. Black stick





## Steps For Removal

1. Gently lift the pull tabs on the speaker flex cables to reveal the locking lever connectors on the logic board. Use a black stick to flip the locking levers up, then disconnect the speaker flex cables by sliding them out of the connectors.

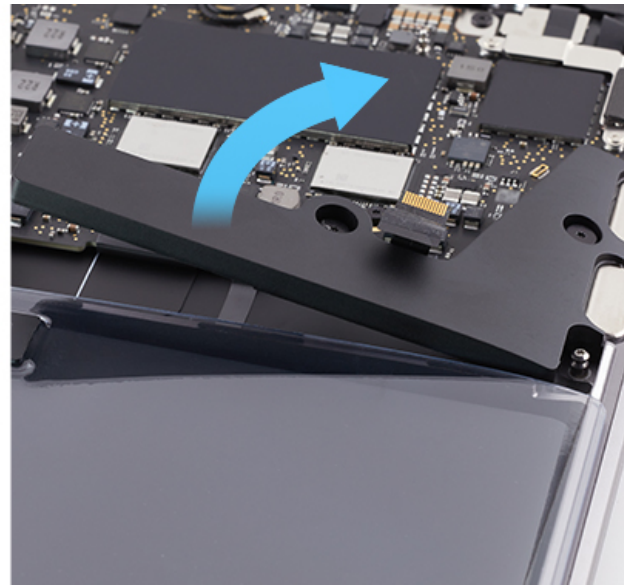
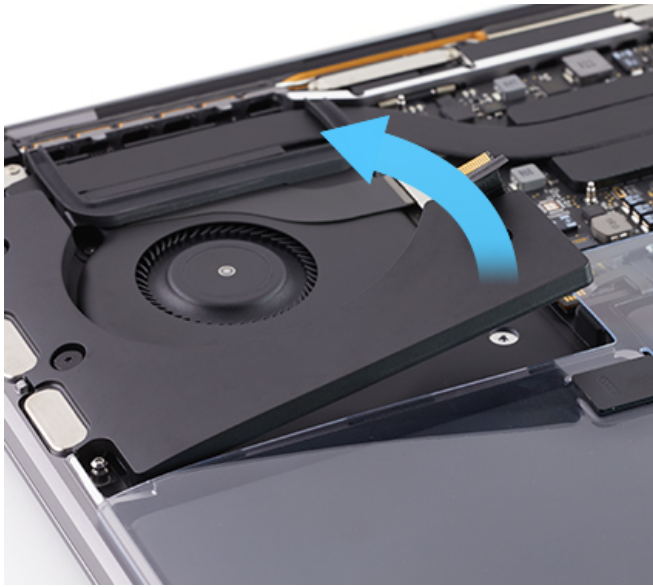


2. Remove three T5 screws from the right speaker and two T5 screws from the left speaker.

**Note:** The screws tighten into rubber grommets and may remain in the screw holes when the speakers are removed.

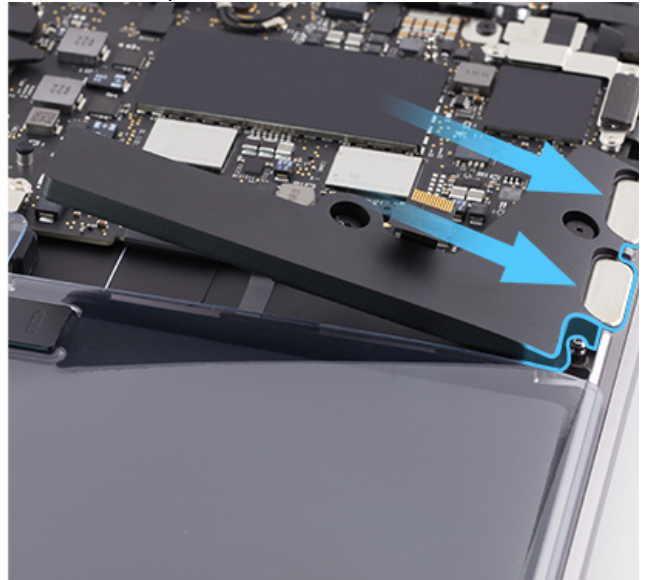
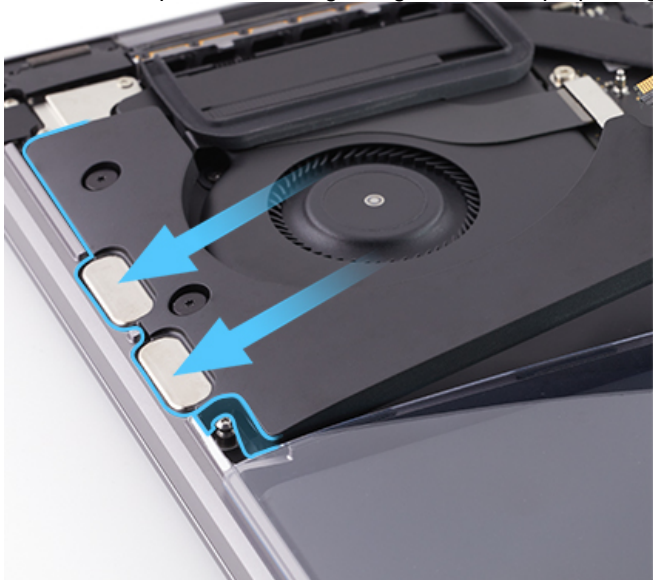


3. Lift the speakers out of the top case.



## Steps For Reassembly

1. Check that the speaker areas in the top case, especially the speaker grilles, are free of any debris before reinstalling the speakers.
2. Reinstall the speakers at a slight angle to ensure proper alignment with the top case.



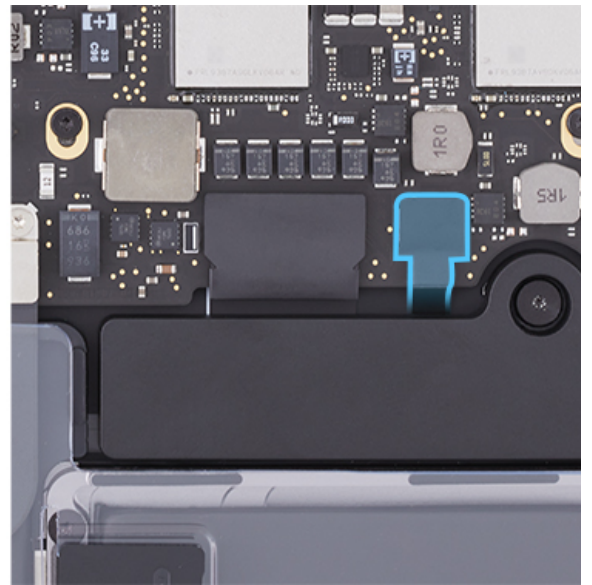
3. Reinstall five T5 screws, three in the right speaker and two in the left speaker.  
**Important:** If the speaker grommets tear or come loose during reassembly, install new ones (923-05267). Use tweezers to gently bend the grommet and thread it through the screw opening in the speaker. The textured side of the grommet should face up. Do not damage the silver foam seals on the edge of the speakers. Check that the grommets fit tightly into the speakers and proceed to reinstall the screws.







4. Reconnect the speaker flex cables to the locking lever connectors on the logic board. Use a black stick to close the locking levers, then adhere the flex cable pull tabs over the connectors.



5. [Reconnect the battery and remove the battery cover.](#)
6. Reinstall the [bottom case](#).

**Important:**

7. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# MacBook Pro (13-inch, M1, 2020) Clutch Covers

## First Steps



### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)



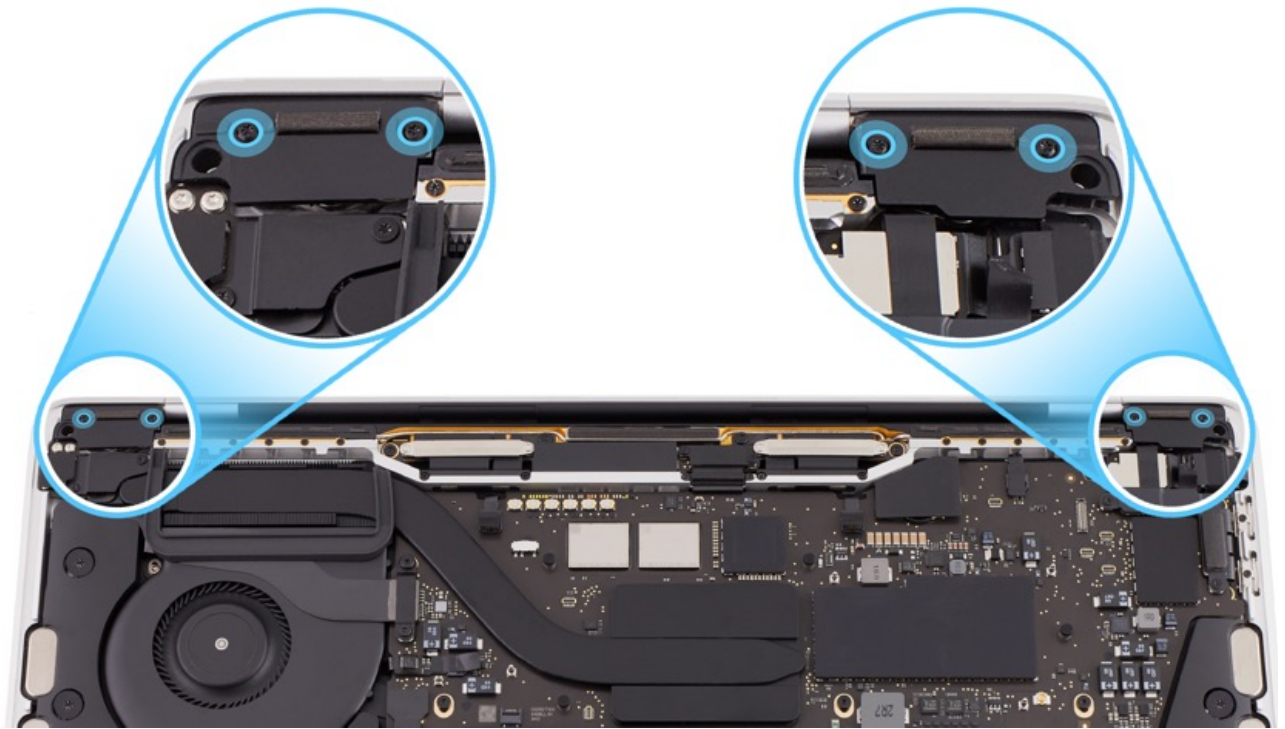
## Tools

1. Black stick
2. Torx T3 screwdriver



## Steps For Removal

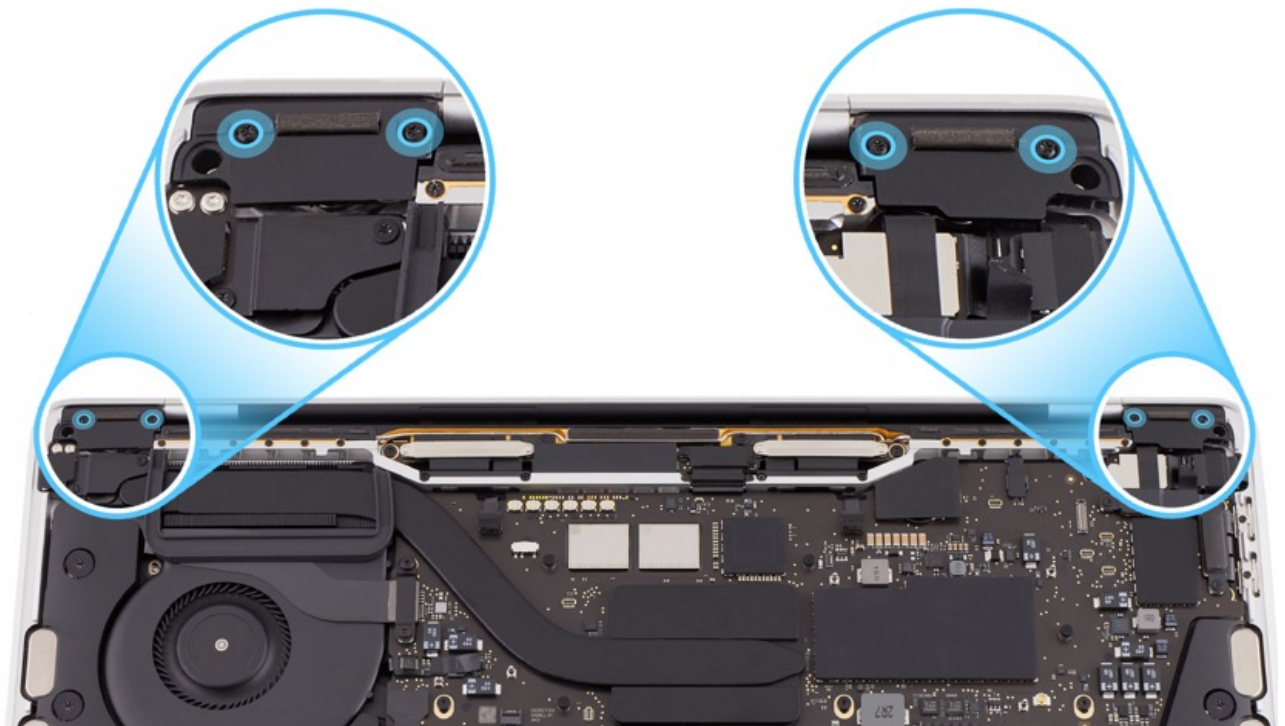
1. Remove two T3 screws from each clutch cover. Then, use a black stick to lift the clutch covers out of the top case.



## Steps For Reassembly

Reinstall the clutch covers in the top case. Ensure the top edge of each clutch cover sits under the top edge of the top case.

1. Reinstall four T3 screws (923-05243), two in each clutch cover.



2. [Reconnect the battery and remove the battery cover.](#)
3. Reinstall the [bottom case](#).

### Important:

5. Run the appropriate [post-repair diagnostic suites](#) (TP1909).



# MacBook Pro (13-inch, M1, 2020) Vent/Antenna Module

## First Steps

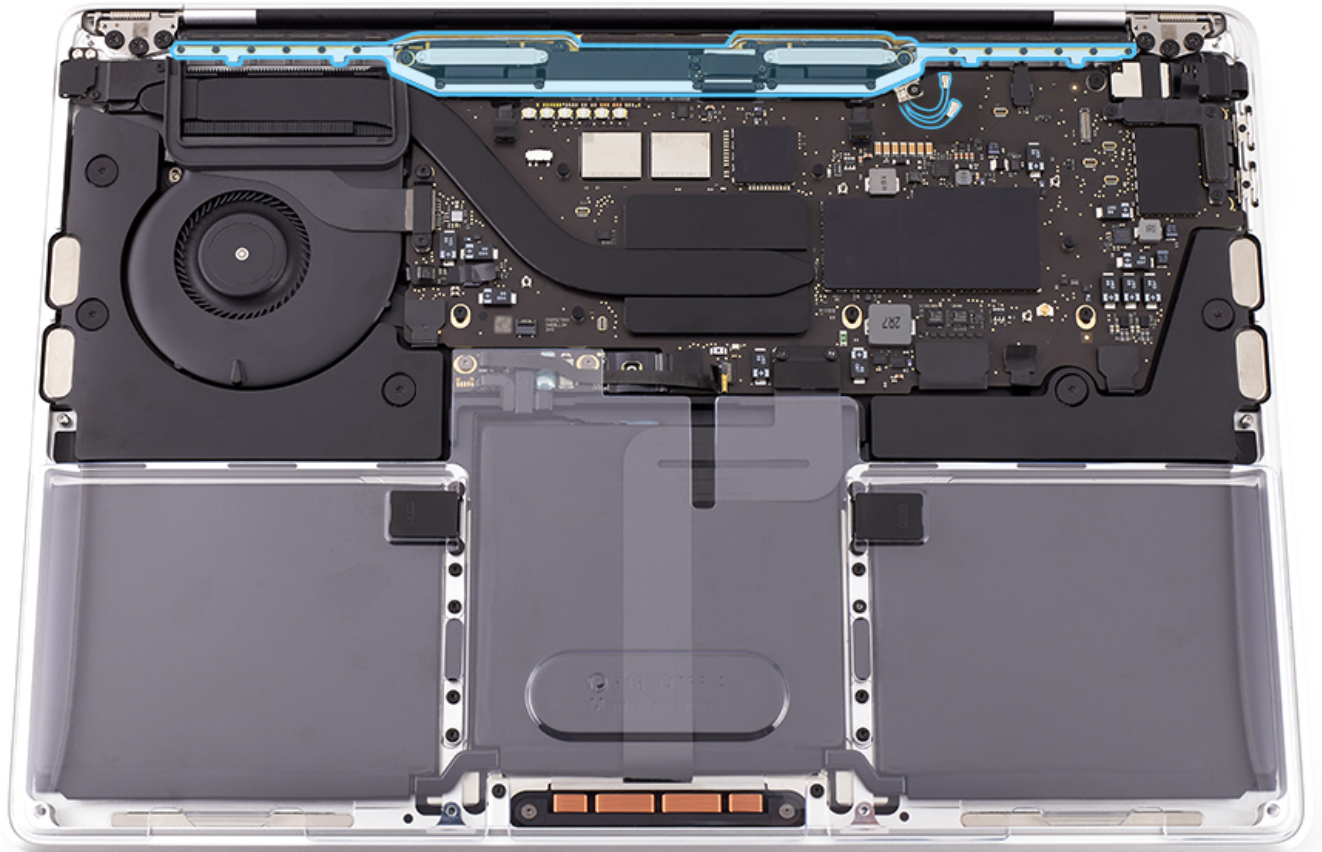


### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)
- [Clutch Covers](#)



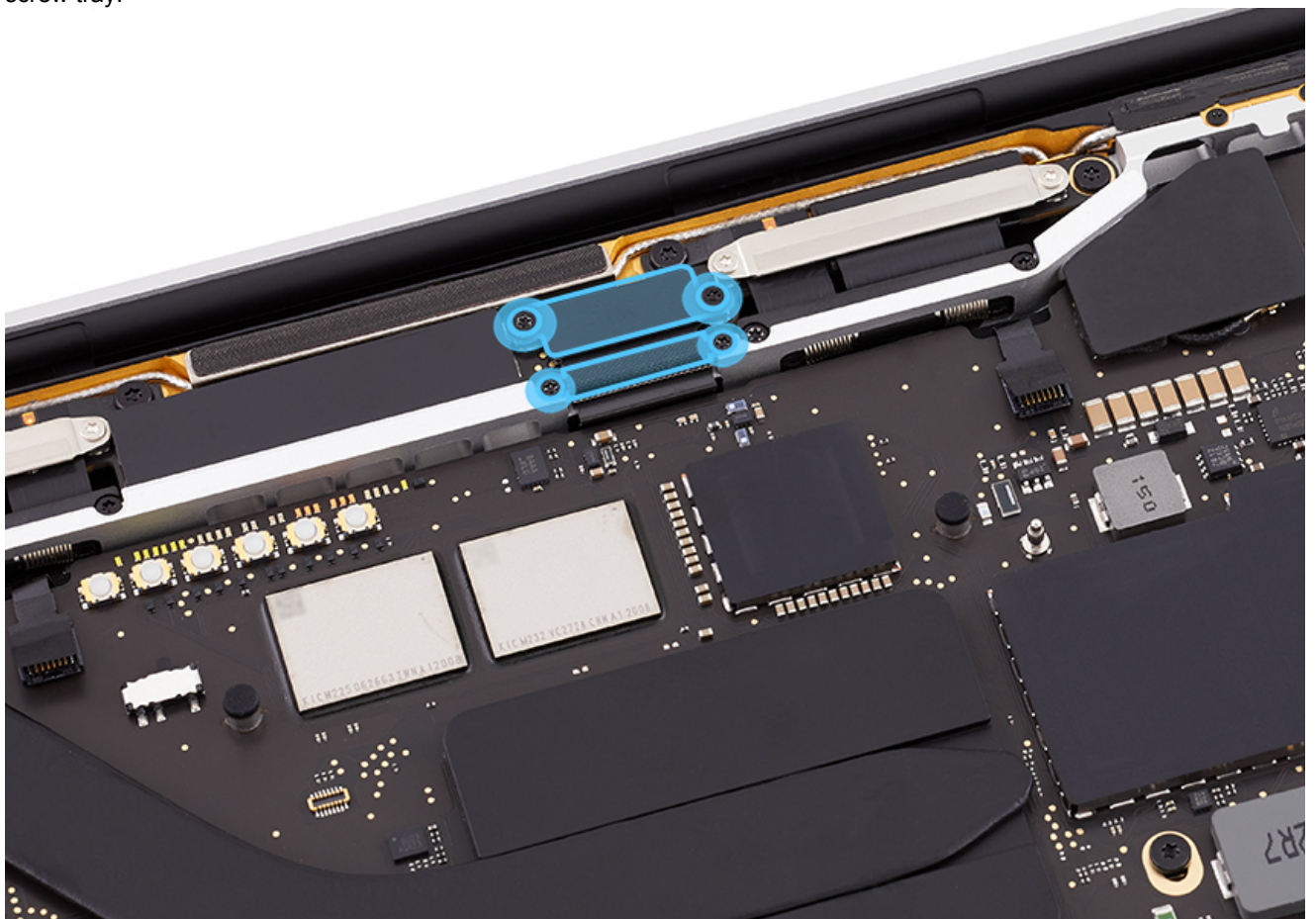
## Tools

1. Antenna tool (923-01322)
2. Black stick
3. Torx T3 screwdriver
4. Torx T5 screwdriver
5. Torx security bit, 1IPR (923-0247)
6. Torque driver (blue), 0.65kgf-cm (923-0448)
7. ESD-safe tweezers



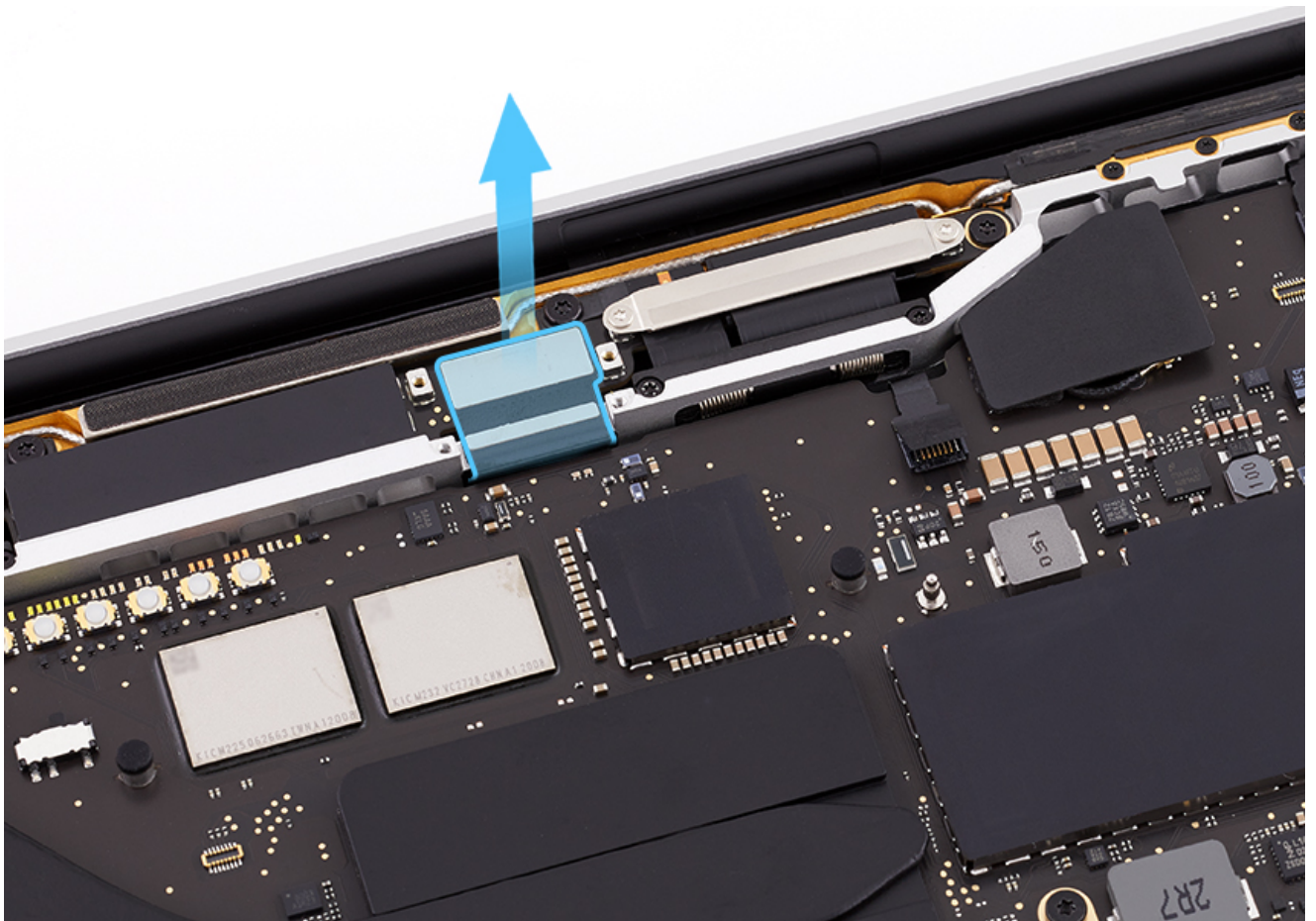
## Steps For Removal

1. Remove four T3 screws, two from the embedded Display Port (eDP) connector cowling and two from the eDP flex cable cowling. Remove the cowlings and group each cowling with their corresponding screws in separate bins of a screw tray.

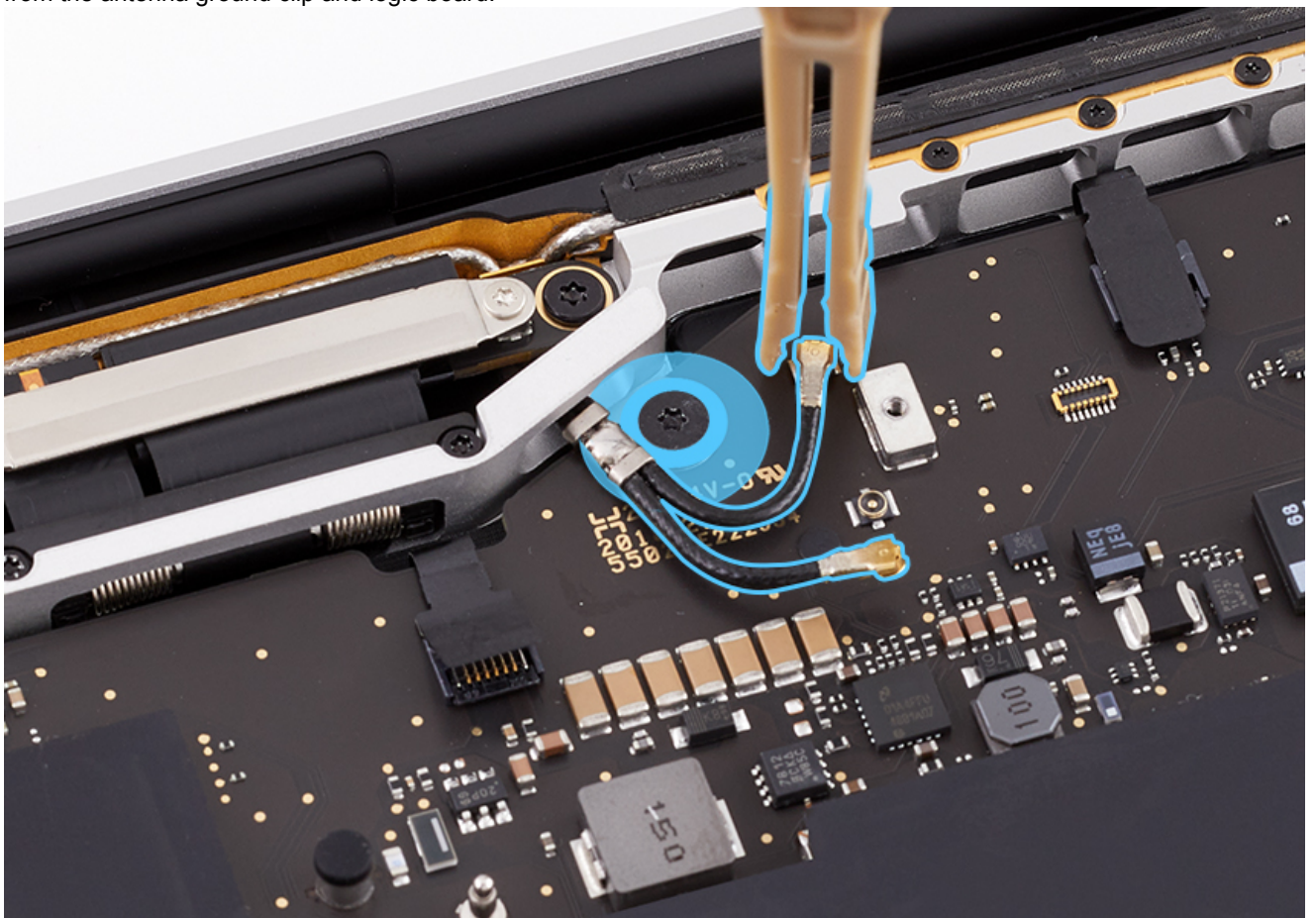


2. Disconnect the eDP flex cable from the connector on the timing controller (TCON) board.



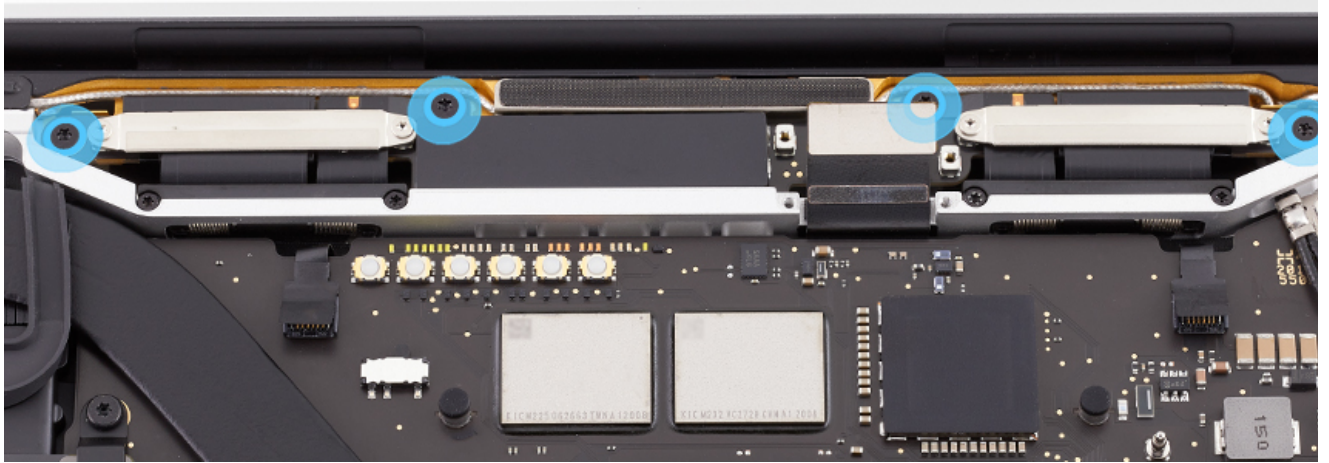


3. Remove and discard the Mylar cover to access the wireless antenna cables and T5 screw.
4. Use the antenna tool to disconnect the two wireless antenna cables from the logic board. Then, remove the T5 screw from the antenna ground clip and logic board.

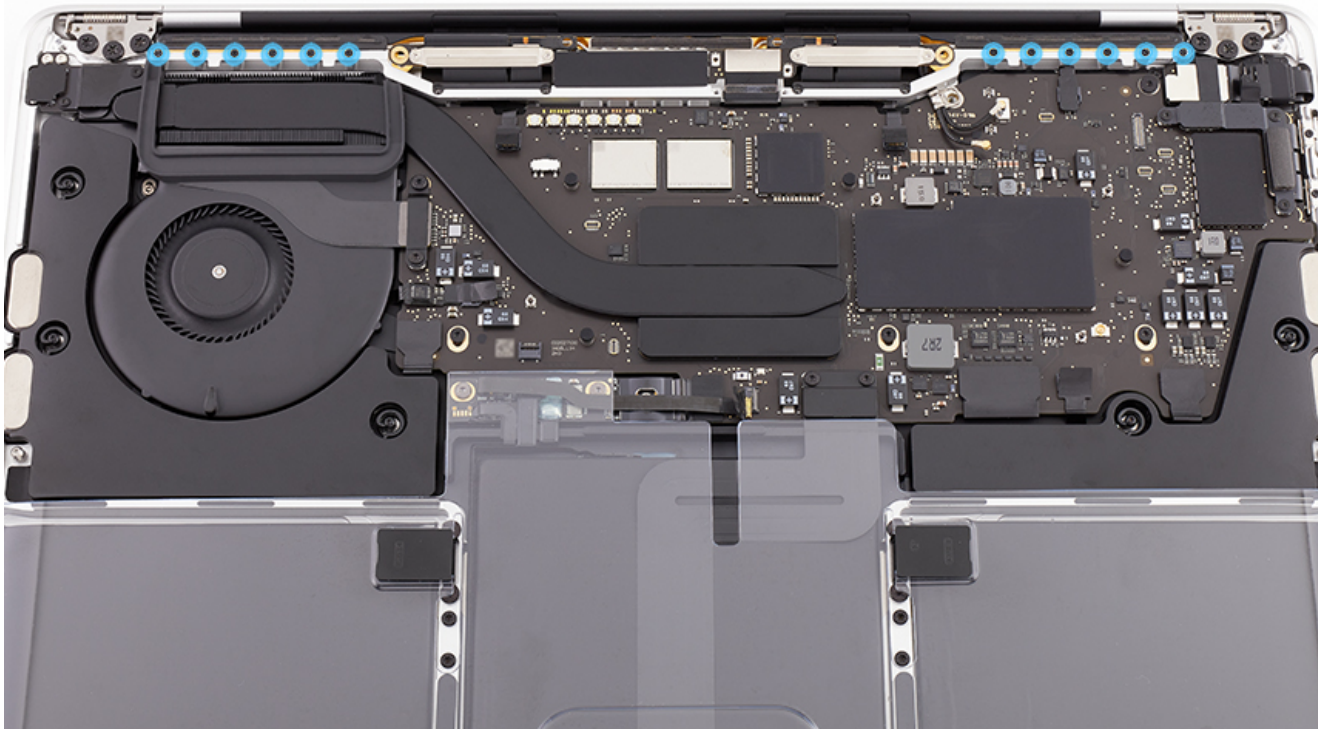


5. Remove four T5 screws from the TCON board.

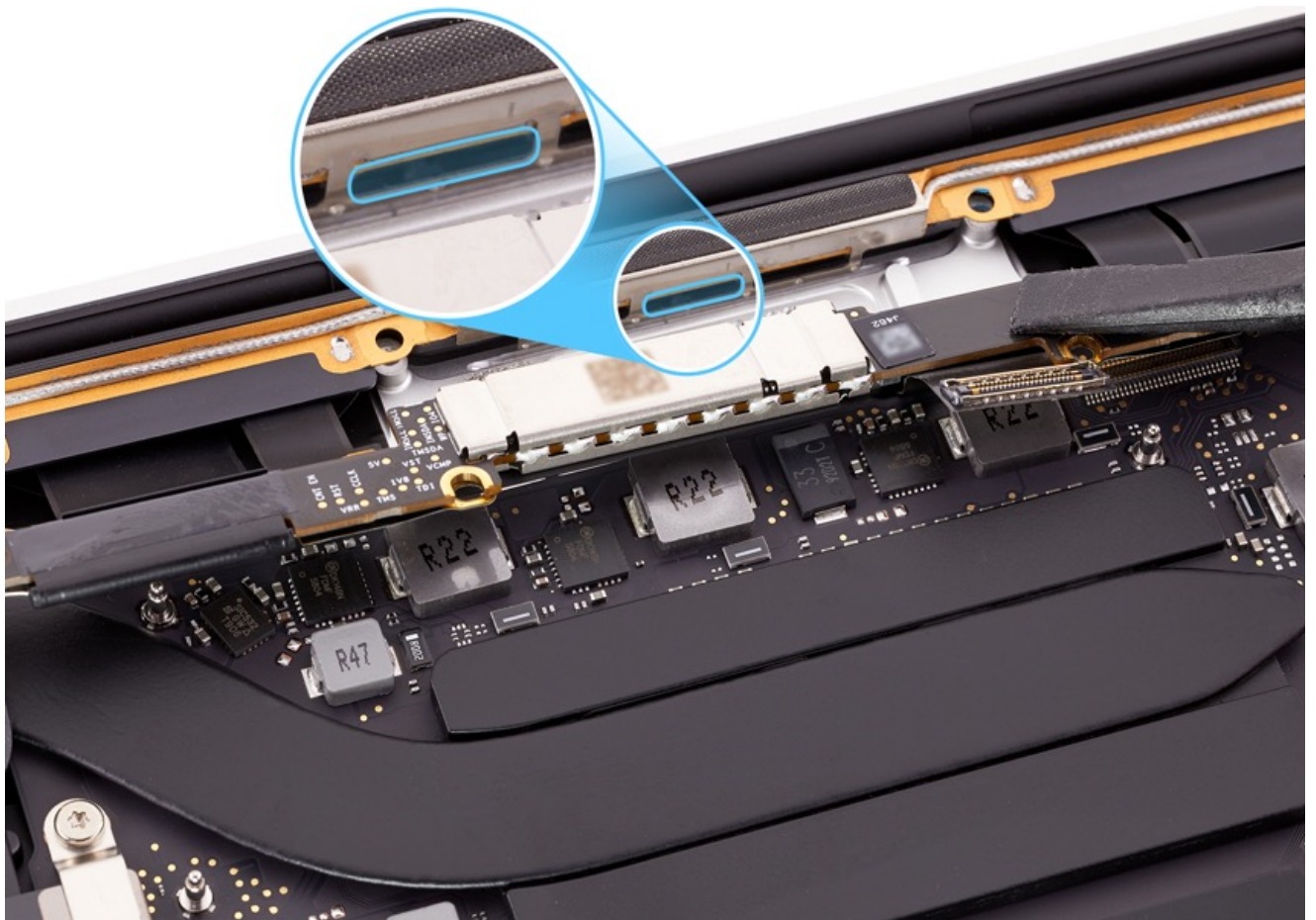




6. Use the torque driver (blue) with the Torx security bit to remove twelve 1IPR screws on the vent/antenna.

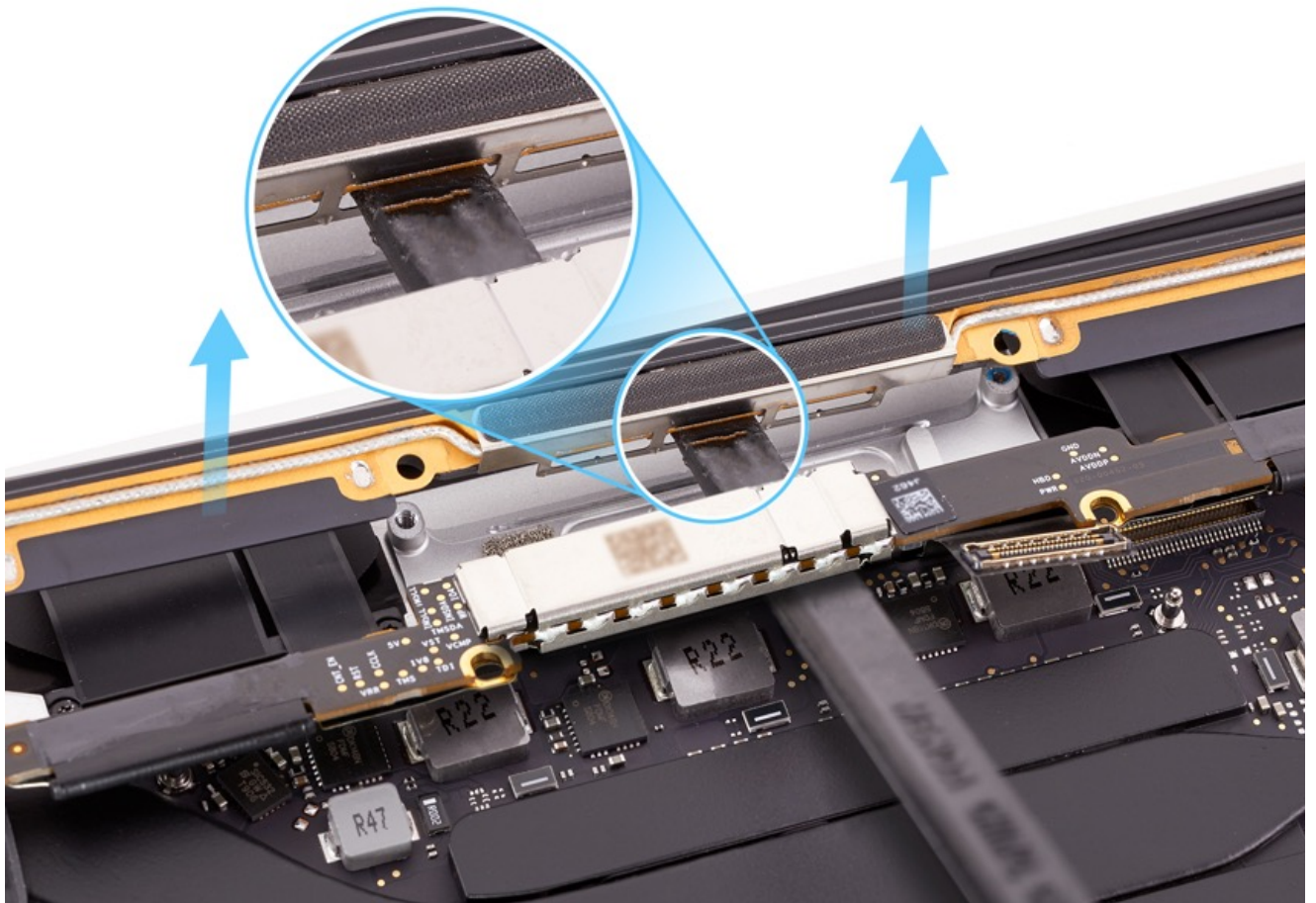


7. Gently lift the TCON board to locate the middle vent slot in the vent/antenna.



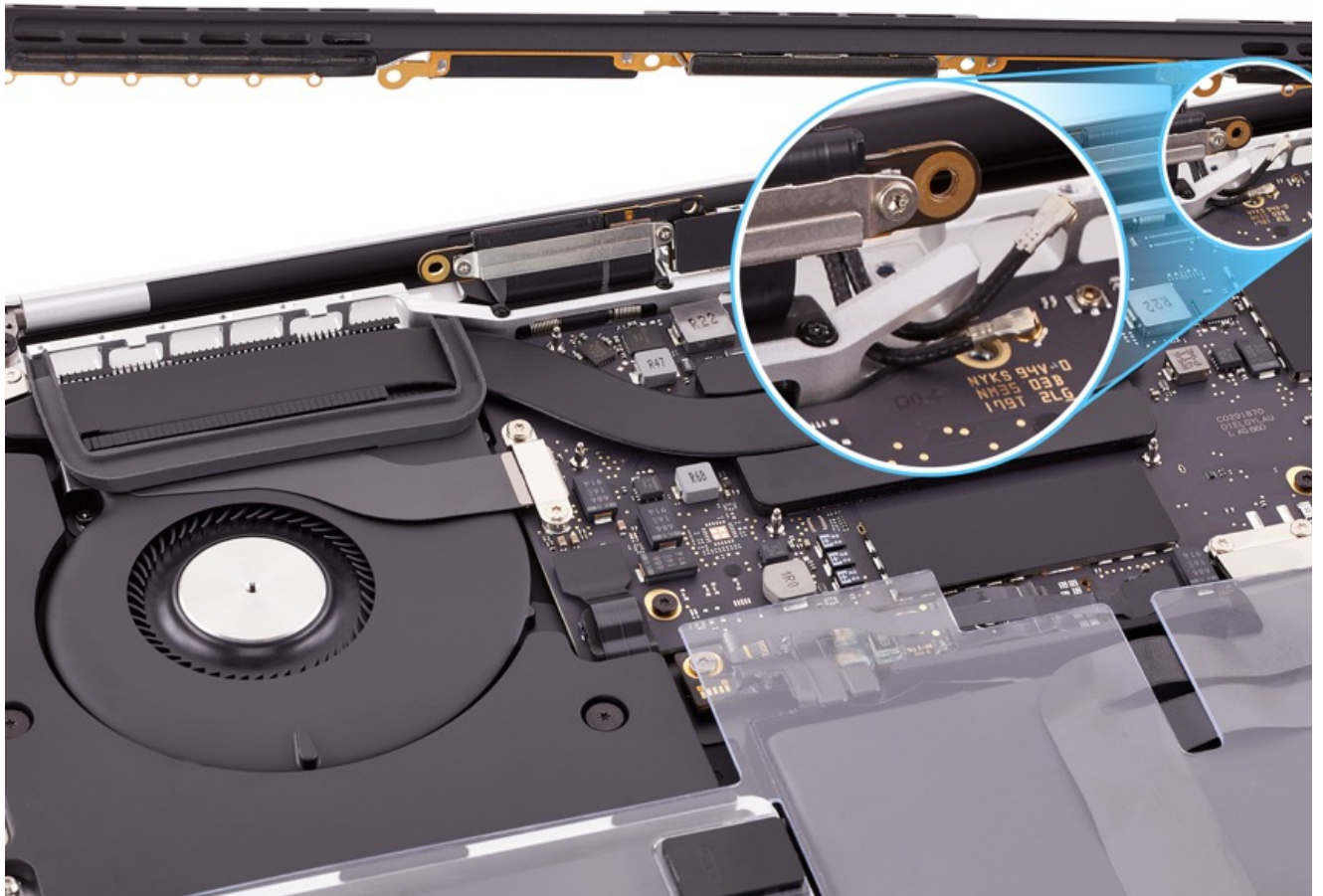
8. Guide the flat end of the black stick under the TCON board and insert it into the middle vent slot. Press down on the pointed end of the black stick to lift the vent/antenna up.

**Note:** You may hear a slight click when the vent/antenna unclips from the top case.



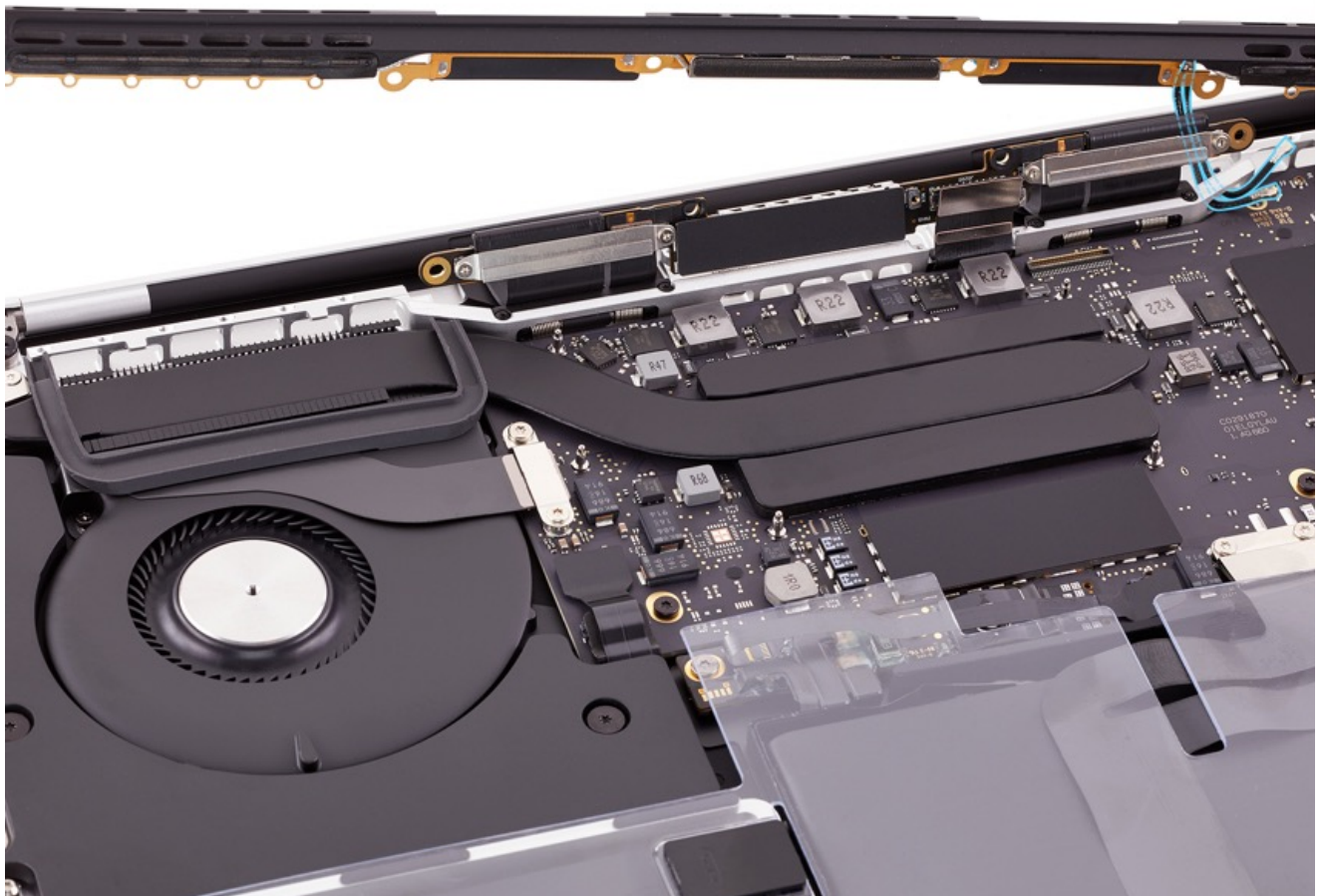
9. Carefully guide the antenna cables and antenna ground clip through the opening in the rear wall as you lift the vent/antenna out of the top case.





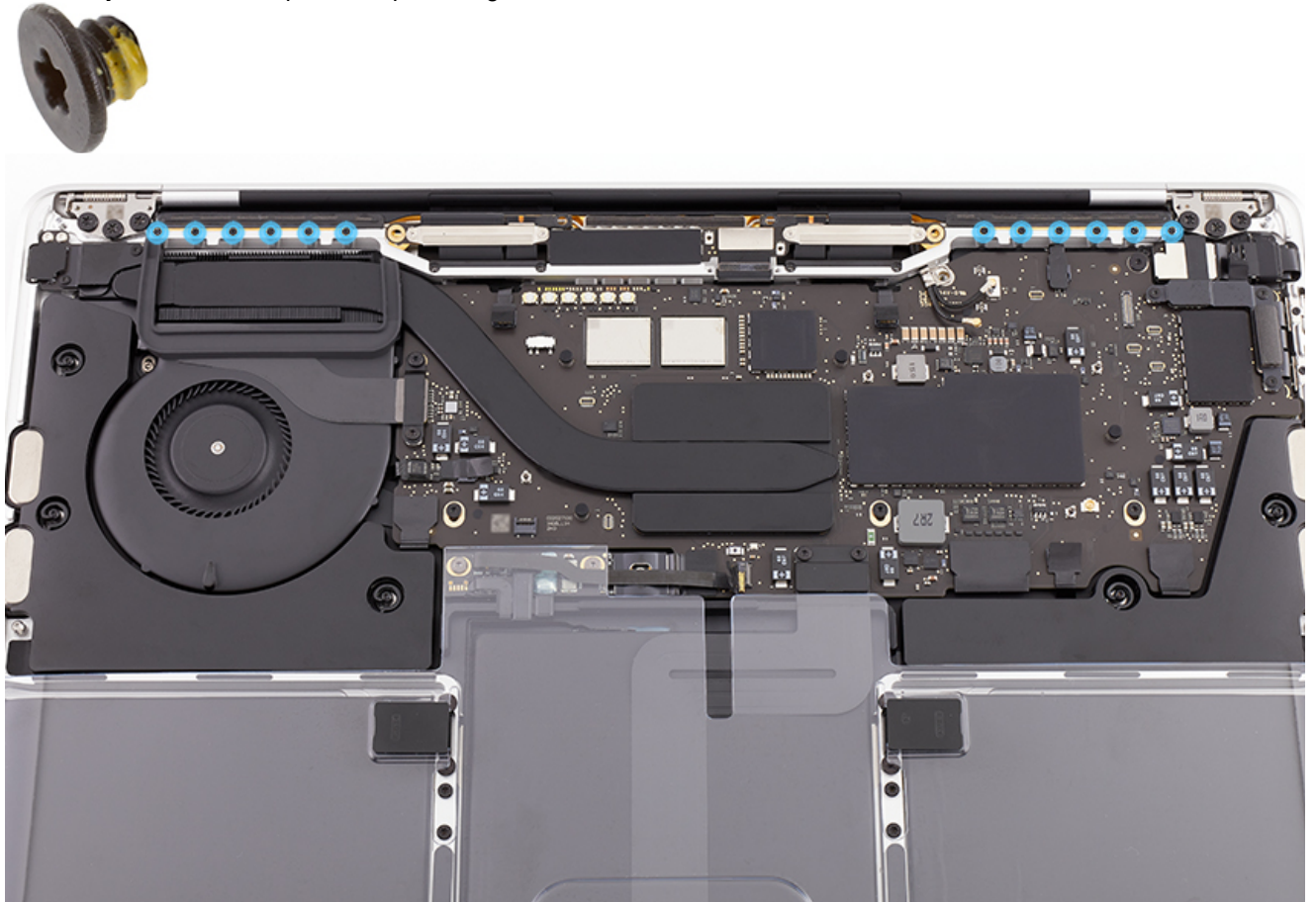
## Steps For Reassembly

1. Route the two antennas and antenna ground clip through the opening in the rear wall. Lower the vent/antenna into the top case. Gently press down on the middle of the vent/antenna to seat it in the top case.  
**Note:** Pressing the vent/antenna into the top case may produce an audible click.

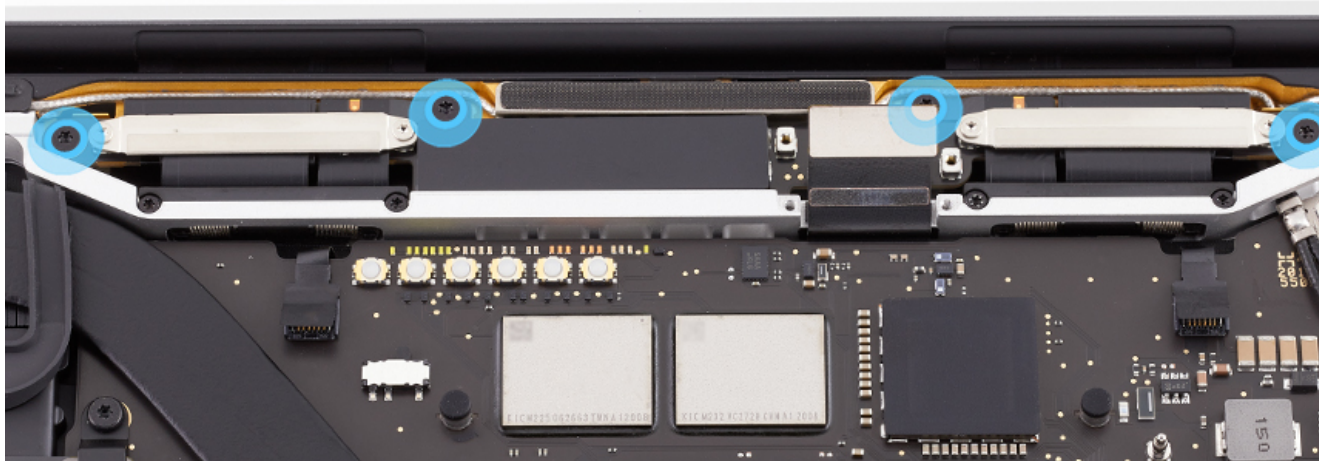


2. Use the torque driver (blue) to reinstall the twelve 1IPR screws (923-05259) in the vent/antenna. Tighten each screw until the torque driver clicks (applies the correct torque).

**Important:** Don't overtighten the screws. The torque driver should prevent overtightening, however some screws may install fully without the torque driver producing an audible click.



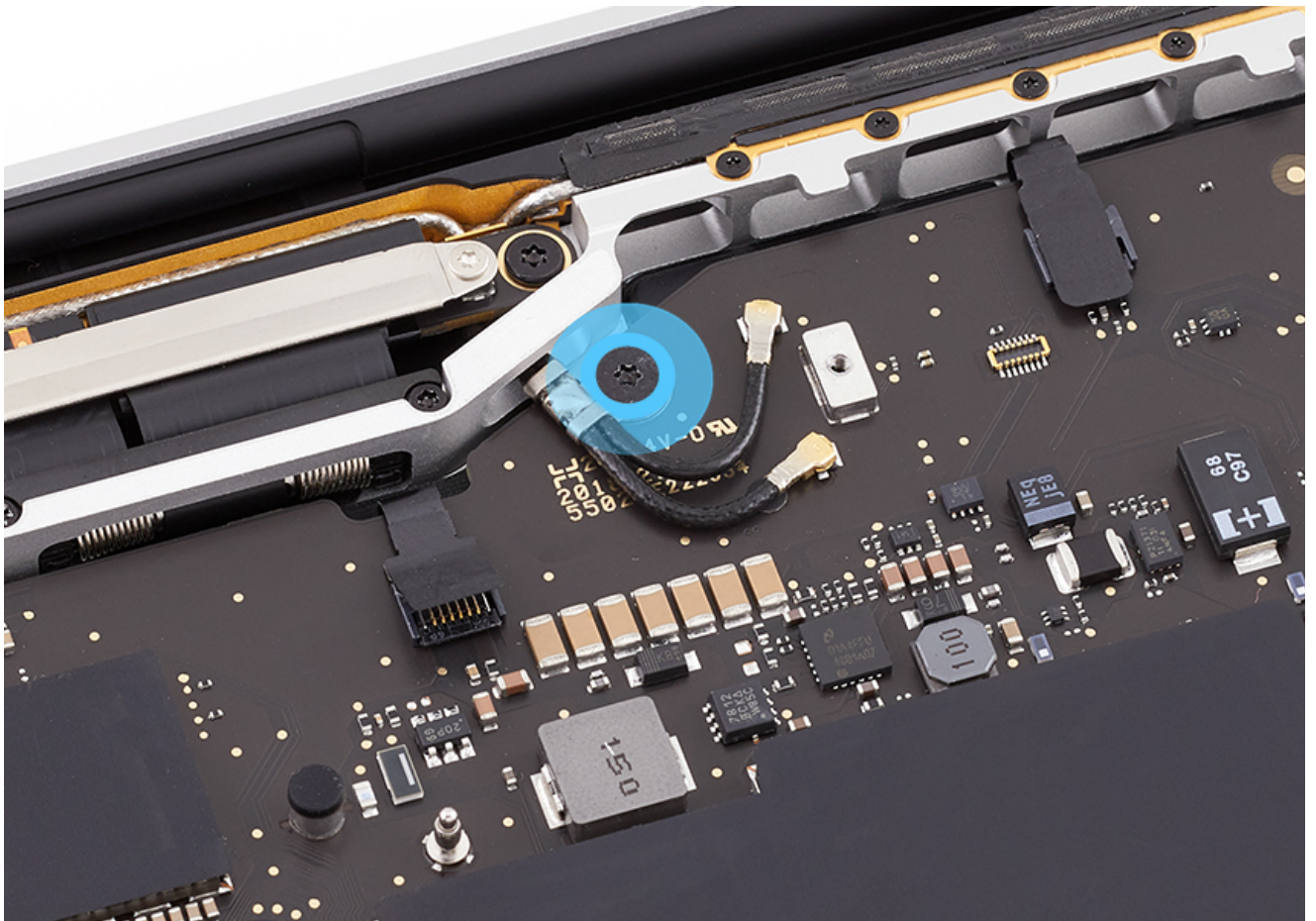
3. Reinstall four T5 screws (923-05245) in the TCON board.



4. Reinstall the one T5 screw (923-05252) to the antenna ground clip and logic board.

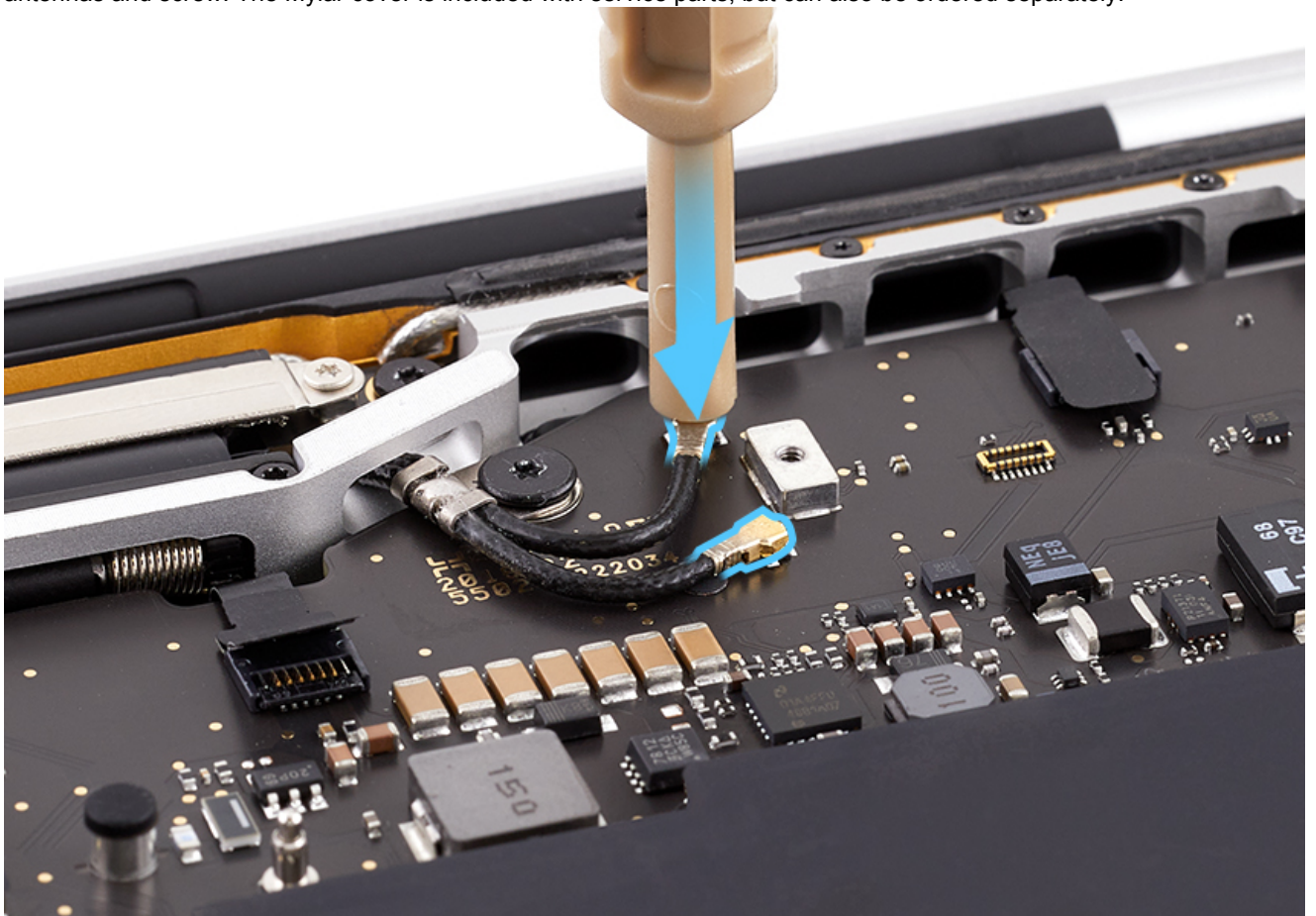






5. Align the antenna heads over the antenna connectors on the logic board. Use the flat end of the antenna tool to press the two antenna heads onto the antenna connectors. Reinstall the cowling and Mylar cover.

**Caution:** To prevent damage caused by loose debris, install a new Mylar cover (923-04328) over the wireless antennas and screw. The Mylar cover is included with service parts, but can also be ordered separately.



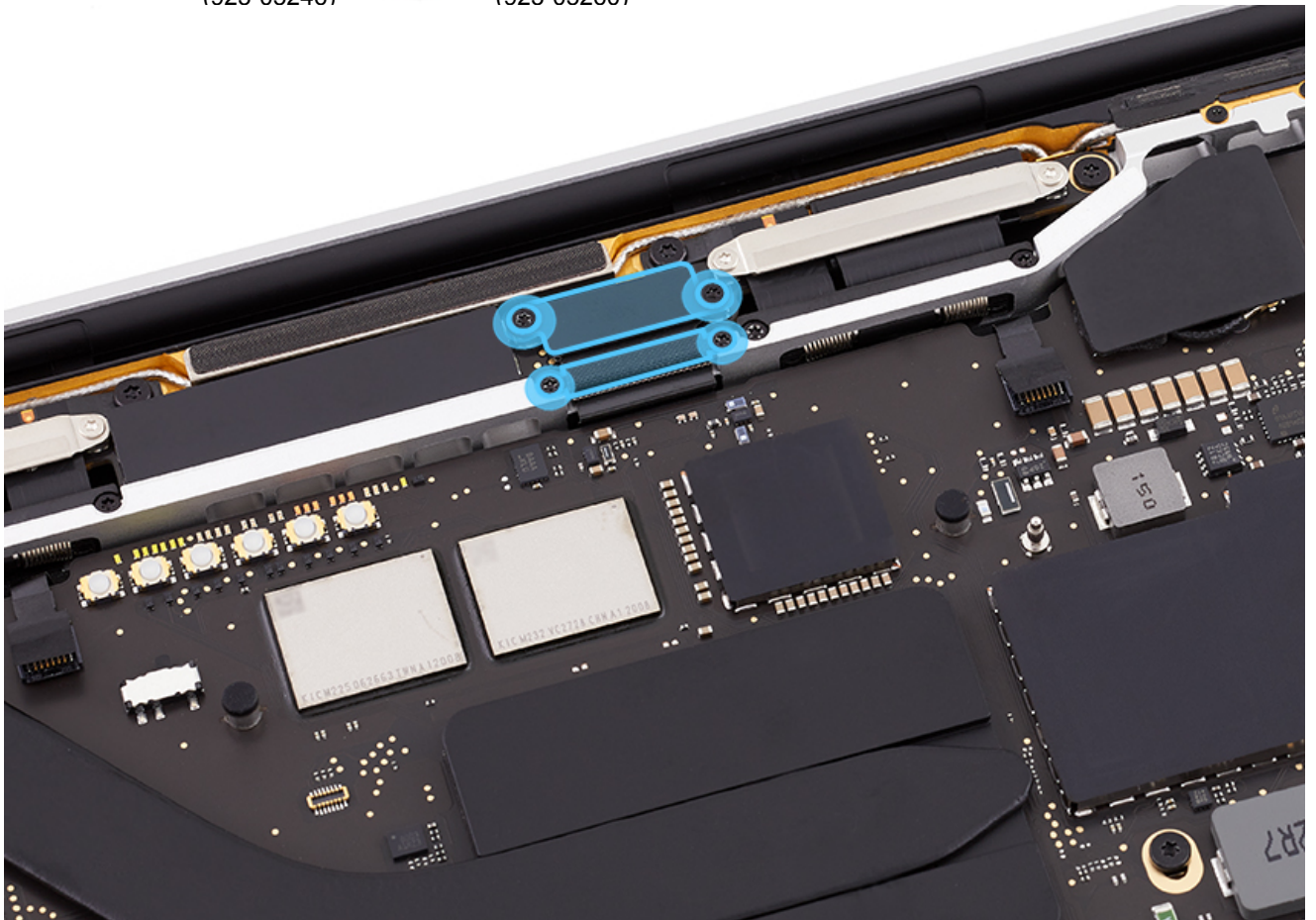
6. Reconnect the eDP flex cable to the connector on the TCON board. Reinstall the eDP flex cable cowling (923-05235) and two T3 screws (923-05246). Reinstall the eDP connector cowling (923-05262) and the two T3 screws (923-05260).



(923-05246)



(923-05260)



7. Reinstall the [clutch covers](#).
8. [Reconnect the battery and remove the battery cover](#).
9. Reinstall the [bottom case](#).

**Important:**

10. Run the appropriate [post-repair diagnostic suites](#) (TP1909).



# MacBook Pro (13-inch, M1, 2020) Display

## First Steps



### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### System Configuration:

- **Important:** Completing the [System Configuration suite](#) (TP1901) is required for the [display](#), [logic board](#), [top case](#), and [Touch ID board](#) procedures. Run the System Configuration suite to configure the display with the computer.

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)
- [Clutch Covers](#)
- [Vent/Antenna Module](#)



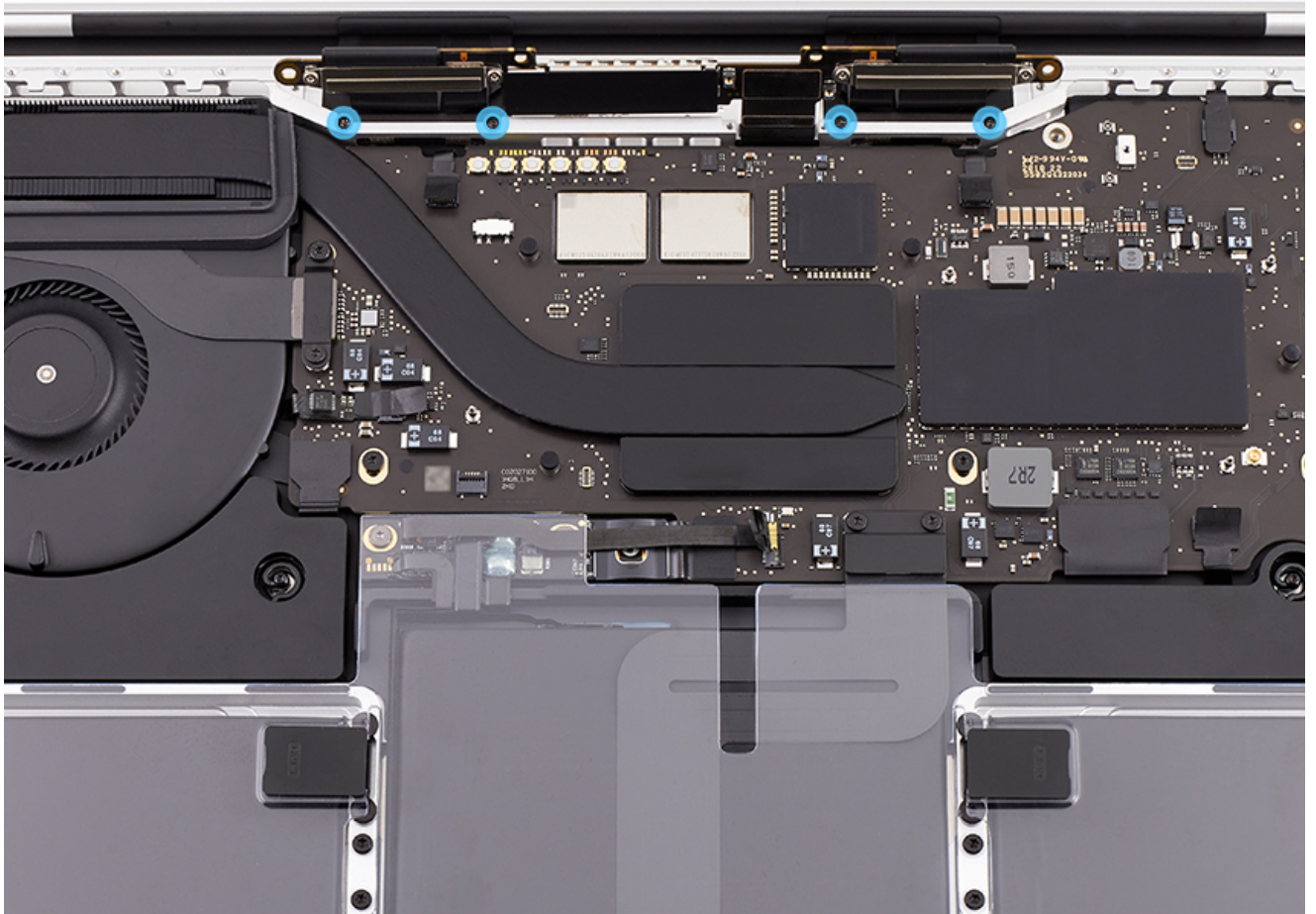
## Tools

1. Black stick
2. Torx T3 screwdriver
3. Torx T8 screwdriver



## Steps For Removal

1. Remove four T3 screws from the spring tensioners. The spring tensioners and timing controller (TCON) board are part of the display.



2. Open the display and carefully place the computer on the edge of a workbench, with the display hanging down.

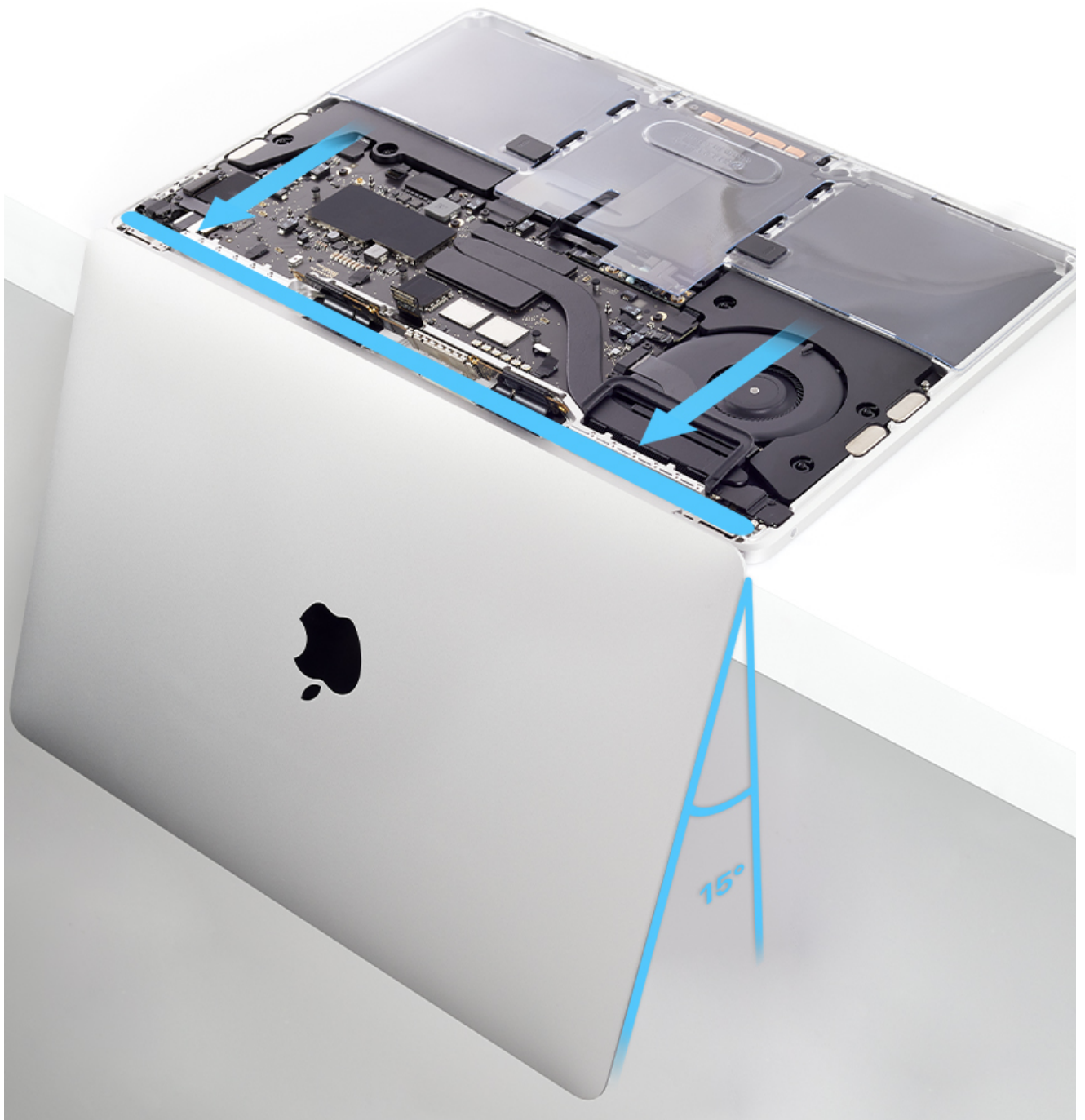


3. Remove six T8 screws from the display clutch mounts.





4. Separate the display from the top case. Tilt the display toward you about 15 degrees, then slide the display out of the top case.



## Steps For Reassembly



**Caution:** If reassembled incorrectly, the TCON board and spring tensioners could get wedged between the top case and display, as shown below.



1. Reinstall the display into the top case. Make sure that the TCON board and spring tensioners are positioned in the top case.





2. Partially reinstall the six T8 screws (923-05266) in the order shown.





3. Close the computer and adjust the display alignment to the top case by touch.

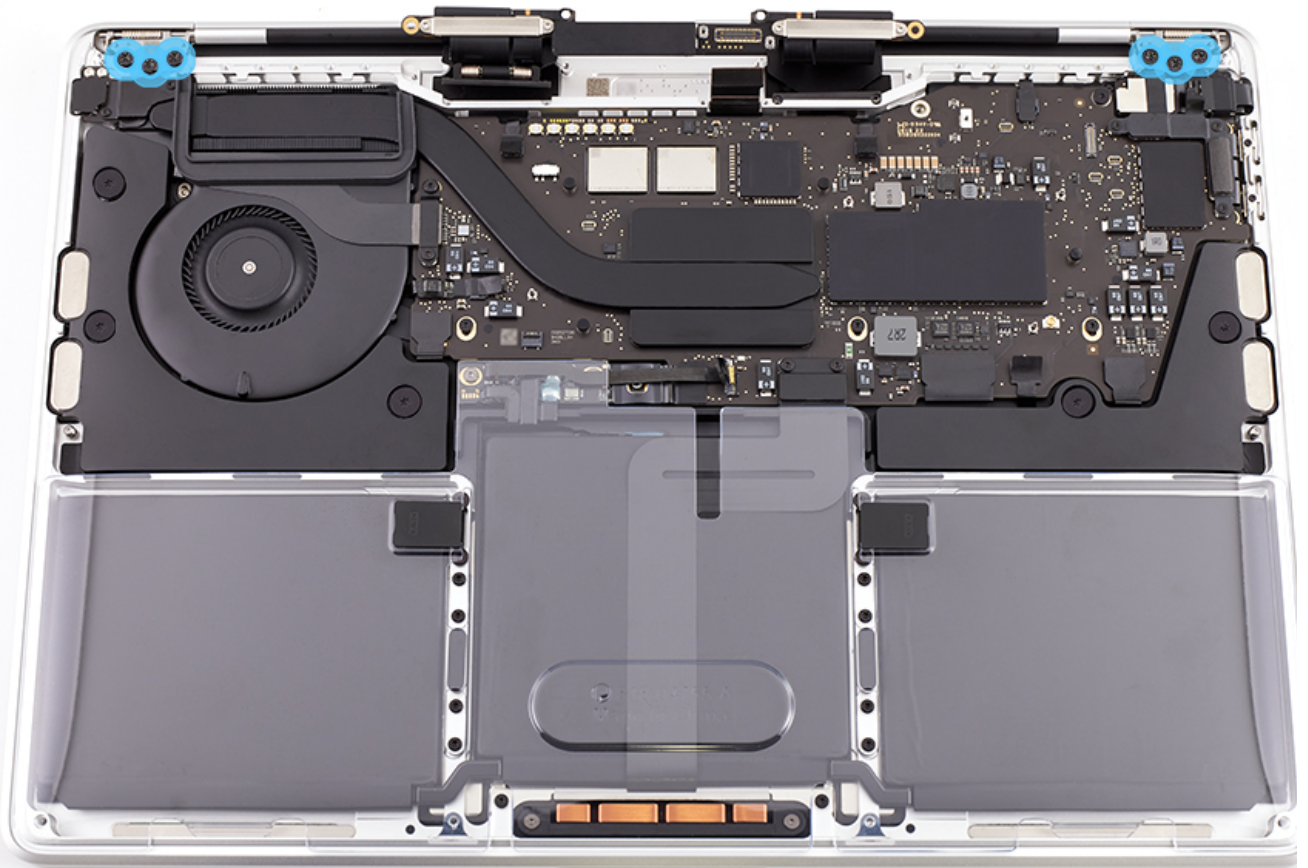




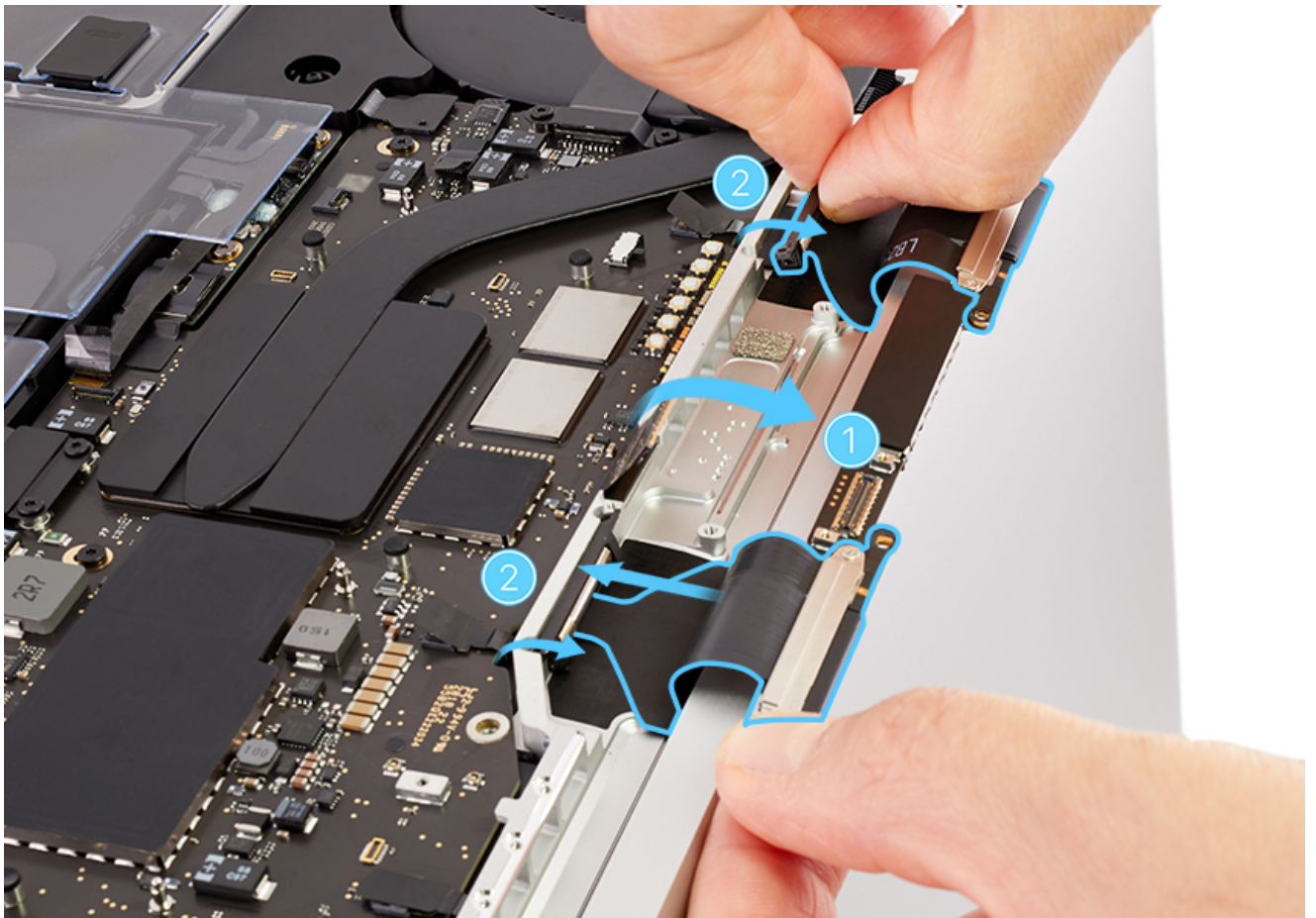
4. Stand up the computer on a clean, flat surface to level the front-to-rear clutch alignment.



5. With the display closed, fully tighten the six T8 screws.

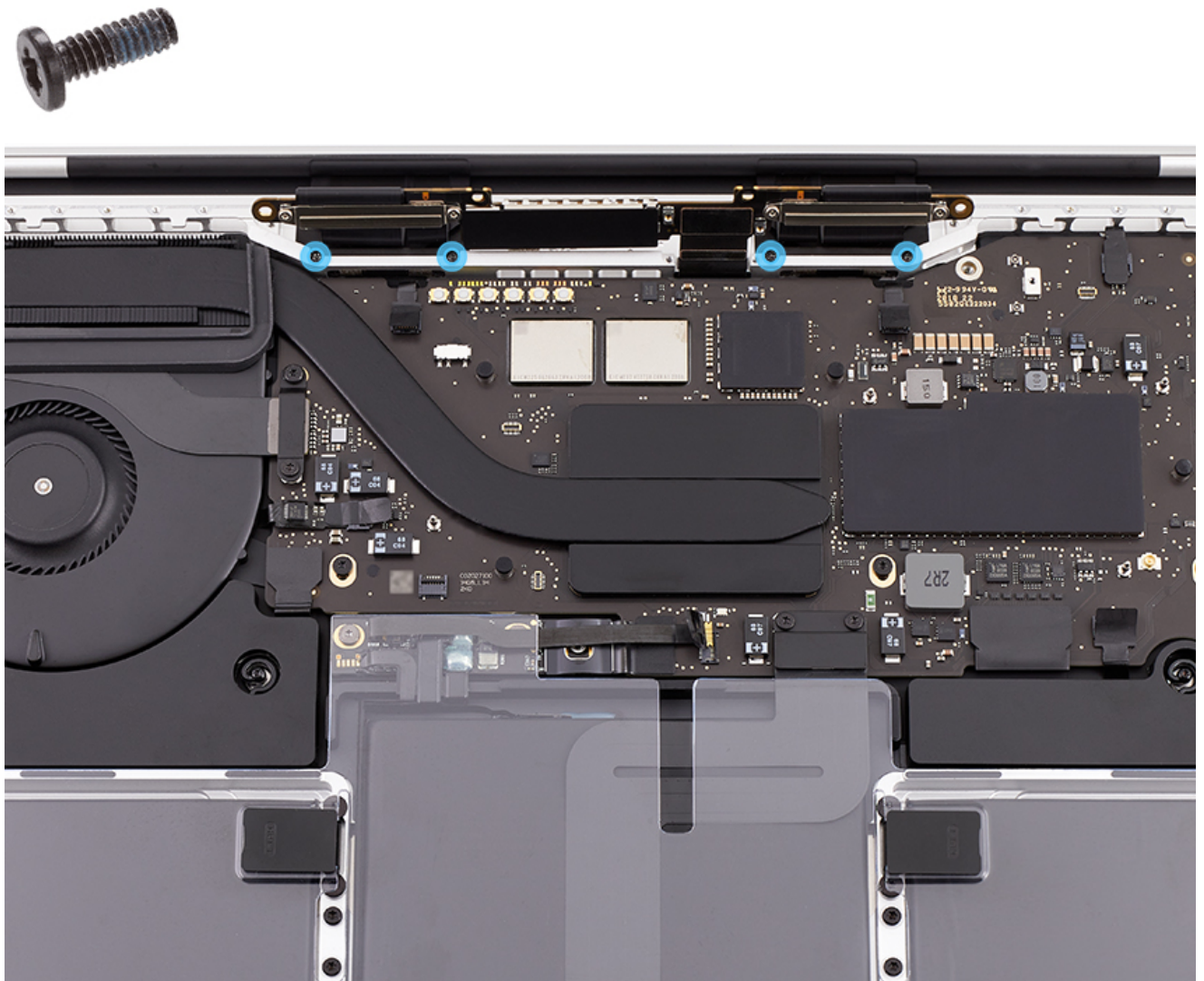


6. Roll (1) and tuck (2) the body of each spring tensioner so it sits flush against the rear wall. The spring tensioner cables should lay completely flat in the top case. The four screw holes in the body of the spring tensioners should align with the screw holes in the rear wall.



7. Reinstall the four T3 screws (923-05251) in the spring tensioners.





8. Reinstall the [vent/antenna module](#).
9. Reinstall the [clutch covers](#).
10. [Reconnect the battery and remove the battery cover](#).
11. Reinstall the [bottom case](#).

**Important:**

12. Run the [System Configuration suite](#) (TP1901) to configure the display with the computer. Completing the System Configuration suite is required for [display](#), [logic board](#), [top case](#), and [Touch ID board](#) procedures.
13. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# MacBook Pro (13-inch, M1, 2020) Audio Board Flex Assembly

## First Steps



### Caution:

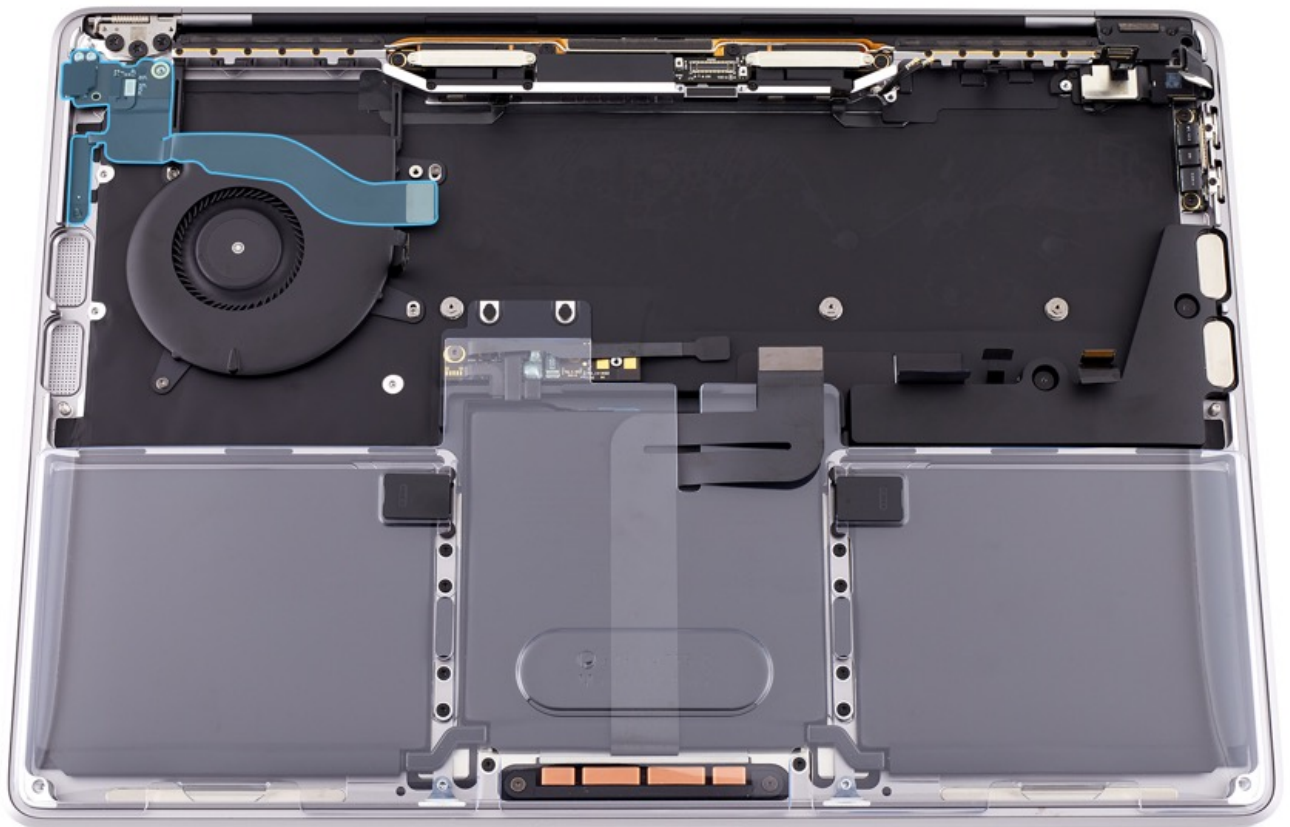
- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Important:

- A new audio board flex assembly must be installed every time it is removed from the top case.

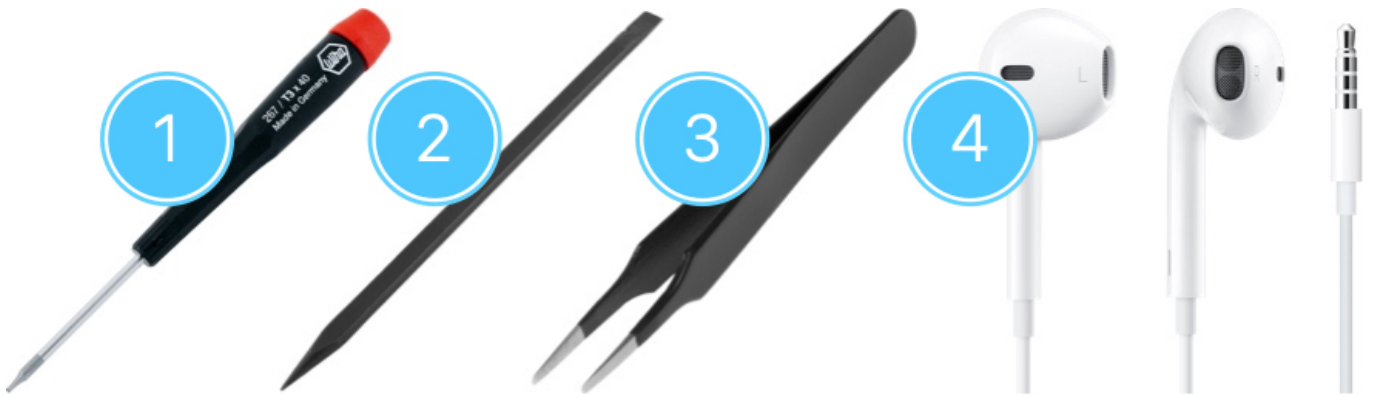
### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)
- [Logic Board](#)
- [Clutch Cover](#) (right only)
- [Speaker](#) (right only)



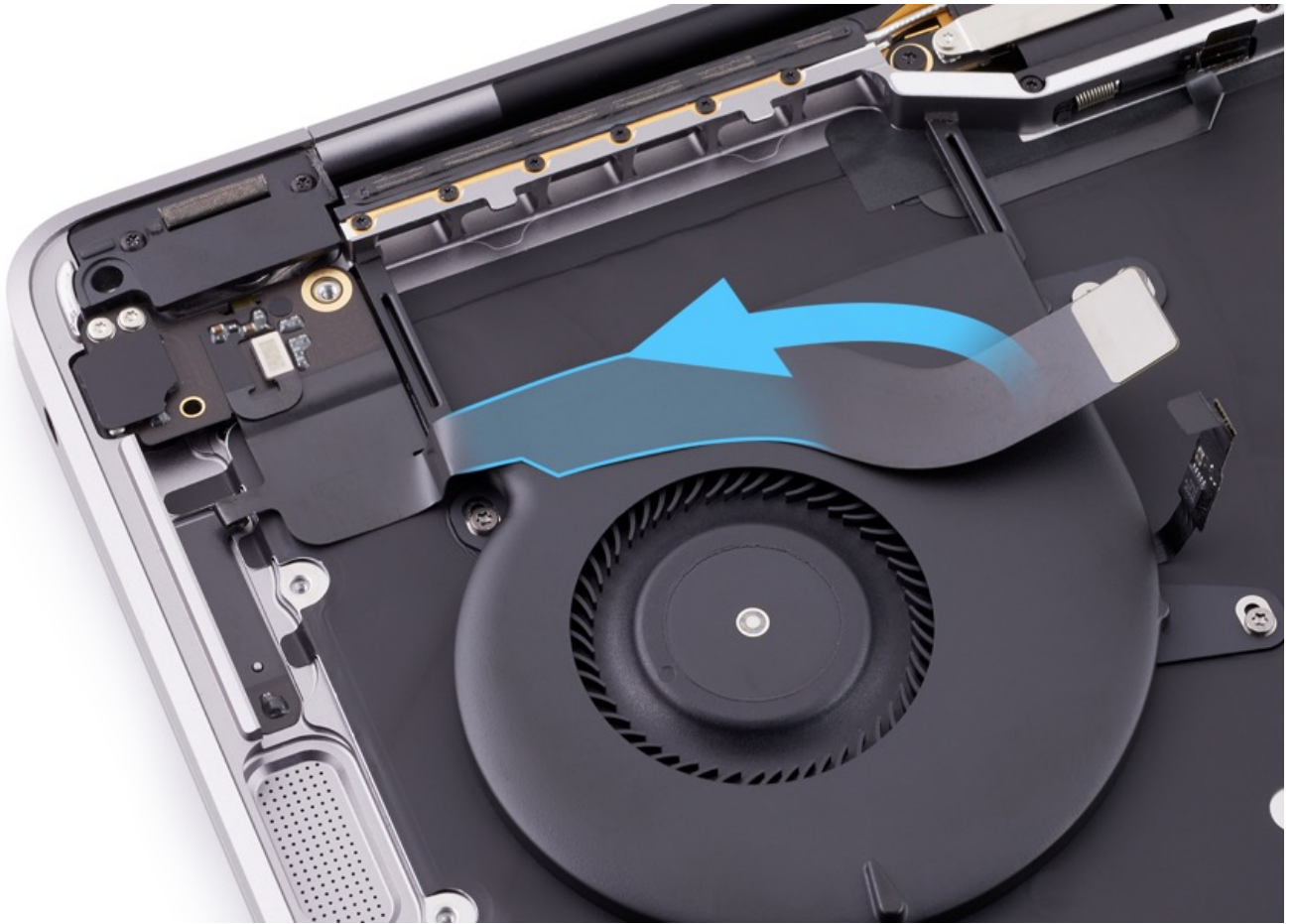
## Tools

1. Torx T3 screwdriver
2. Black stick
3. ESD-safe tweezers
4. EarPods with 3.5 mm headphone jack



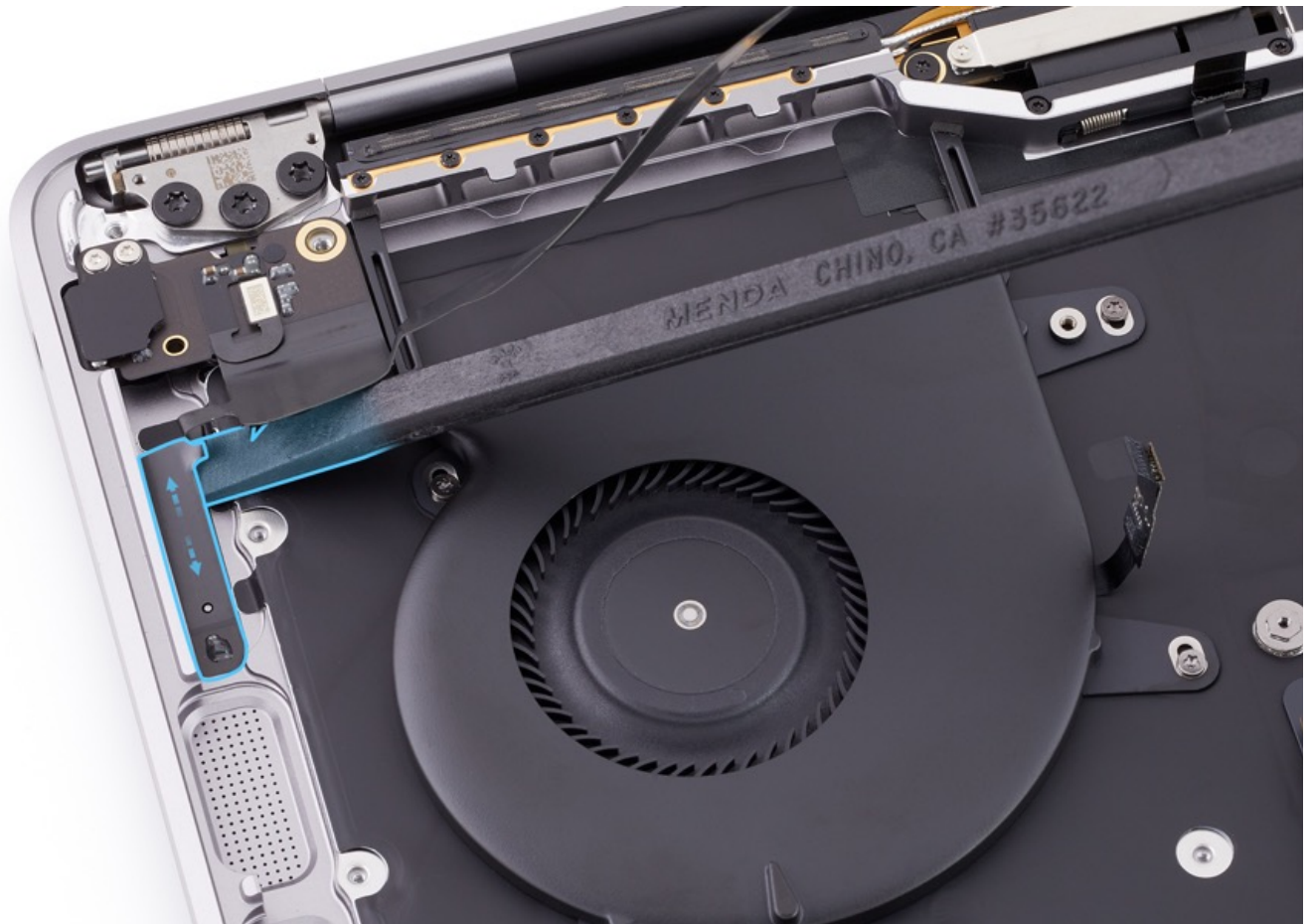
## Steps For Removal

1. The audio board flex assembly cable is adhered to the fan. Gently lift the cable to loosen the adhesive and separate it from the fan.

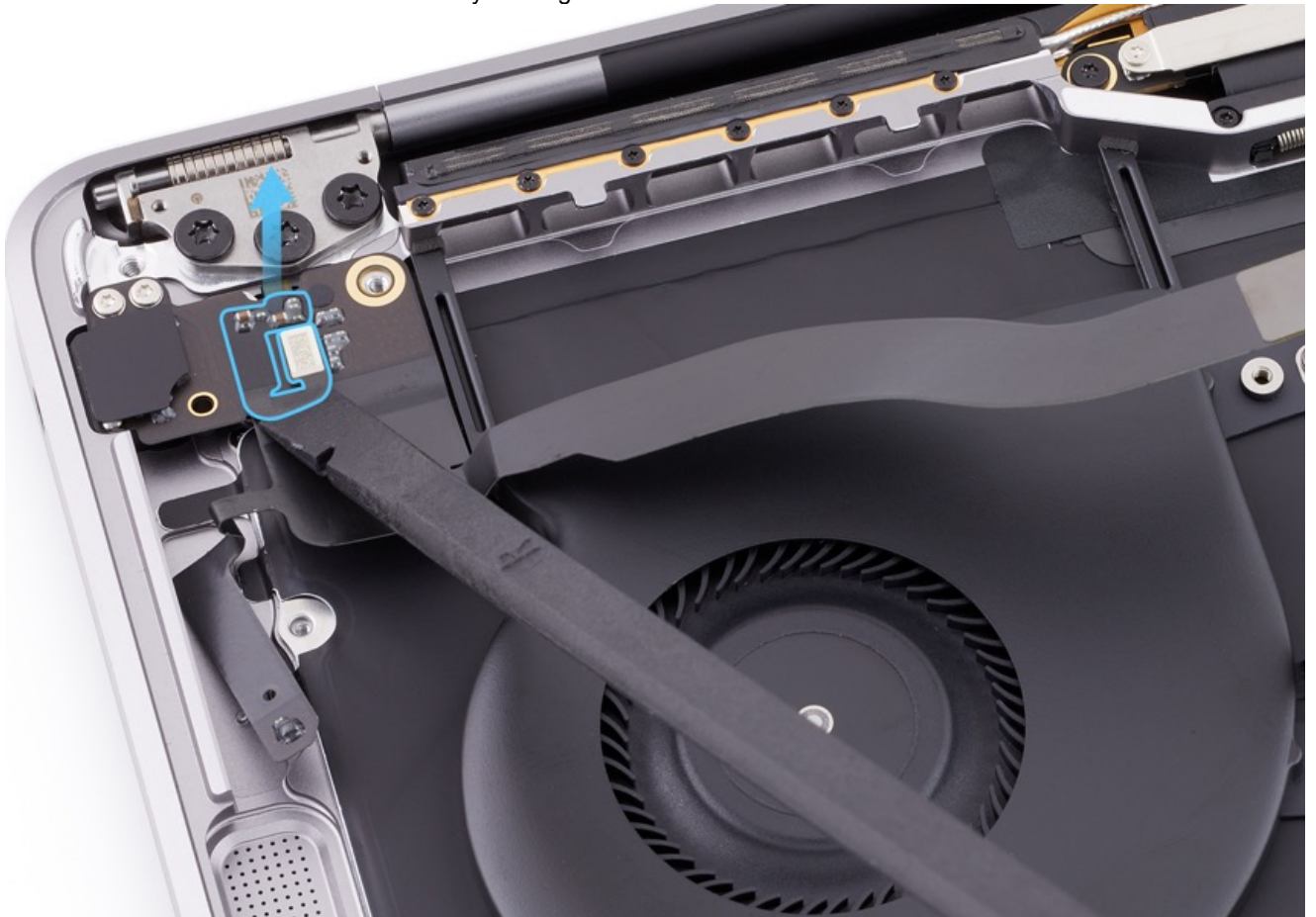


2. Run the flat end of a black stick under the Hall effect sensor cable to loosen the adhesive and separate it from the top case.

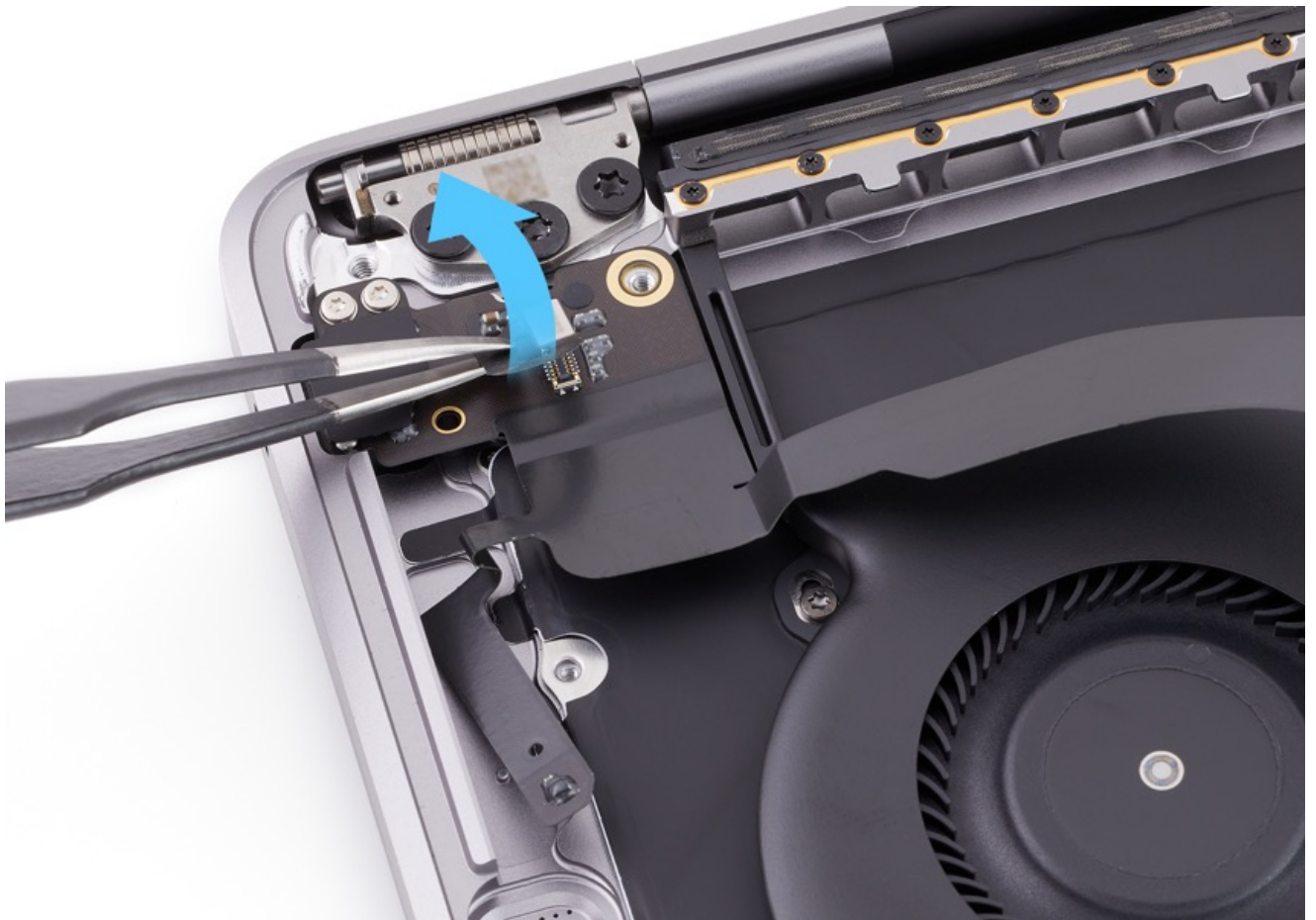




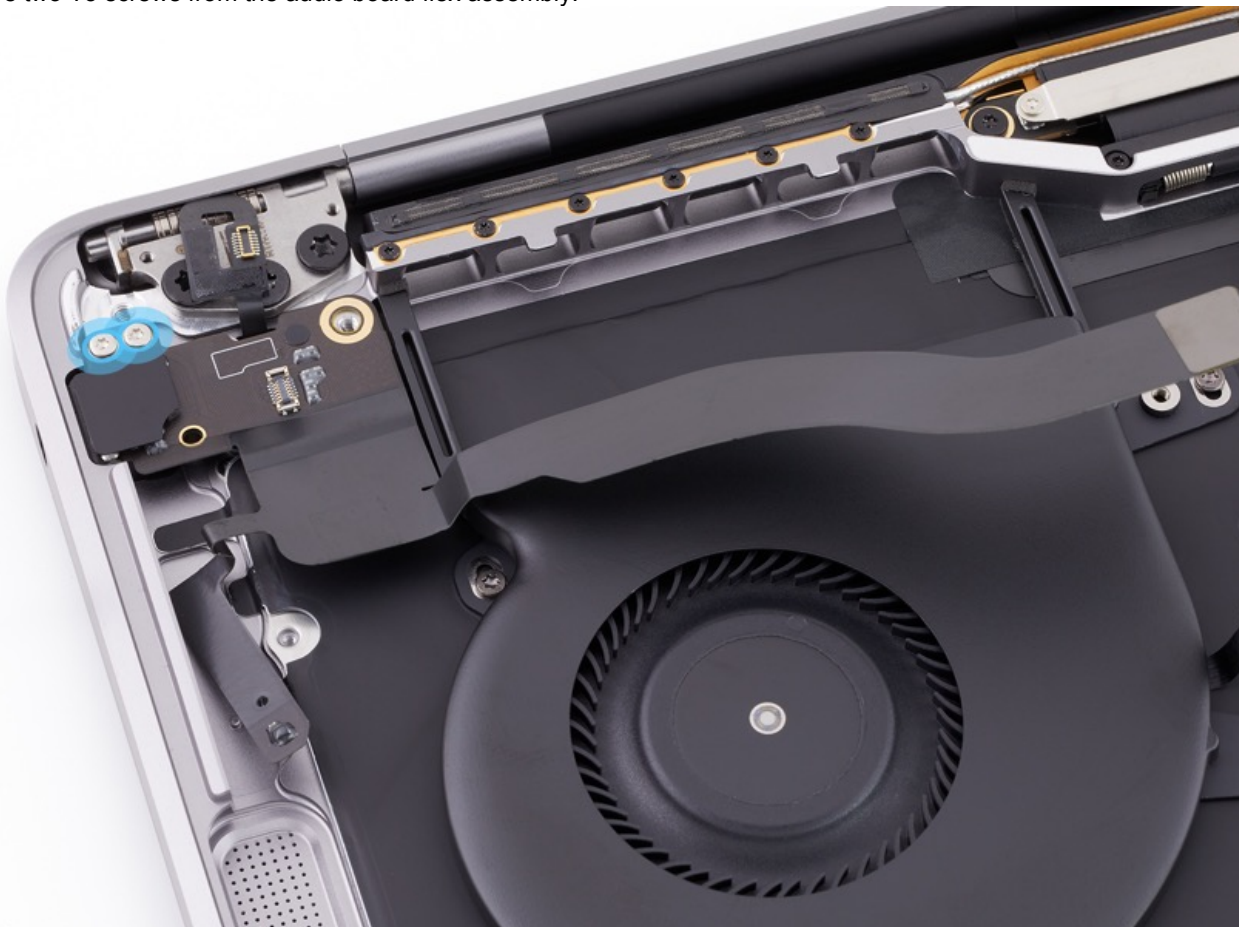
3. Disconnect the Touch ID board flex cable by running the black stick underneath.



4. Use round nose tweezers to loosen the adhesive on the Touch ID board flex cable. Carefully tuck the flex cable under the edge of the top case to keep it from getting damaged during this procedure.

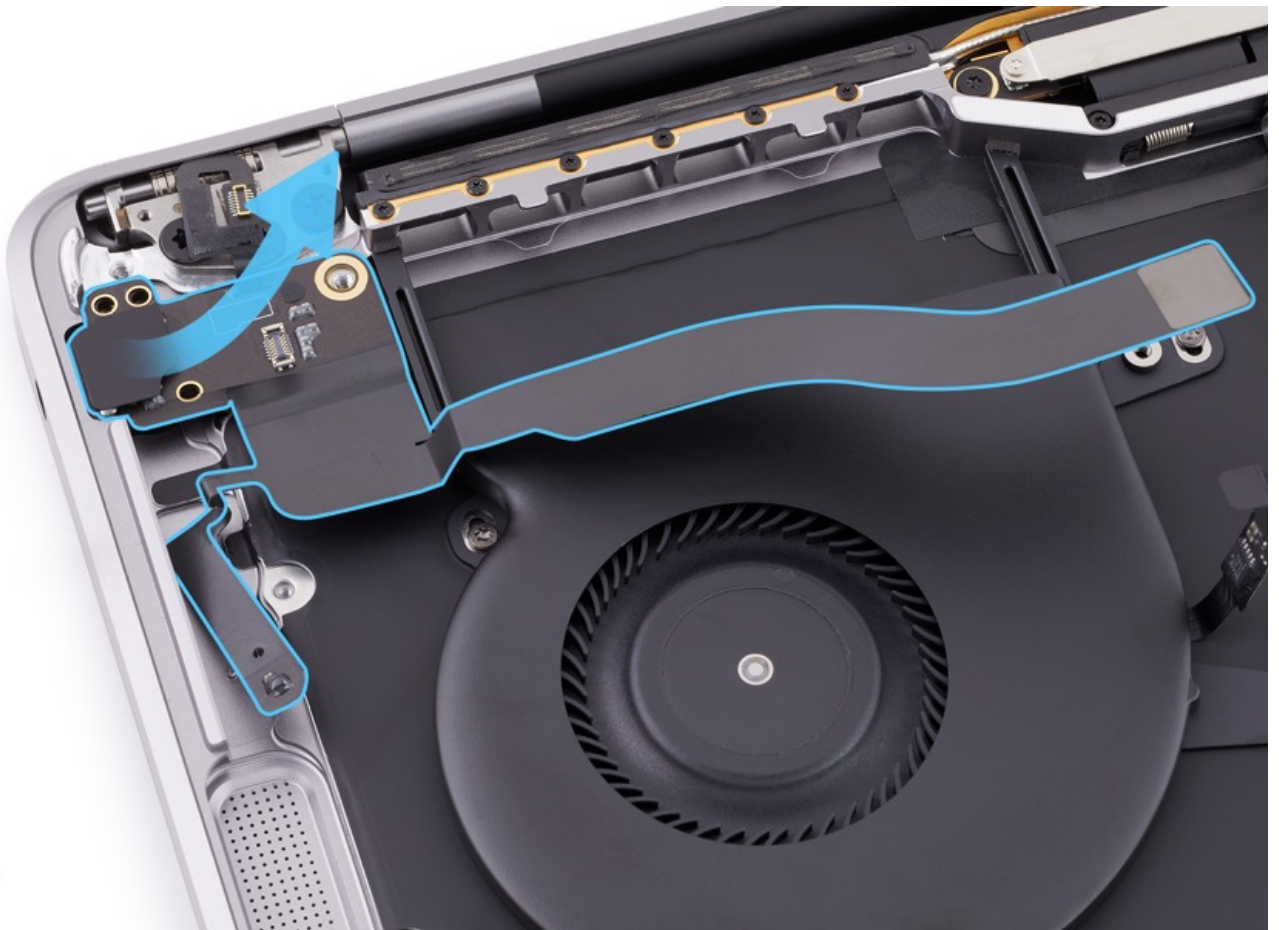


5. Remove two T3 screws from the audio board flex assembly.



6. Lift the audio board flex assembly out of the top case.



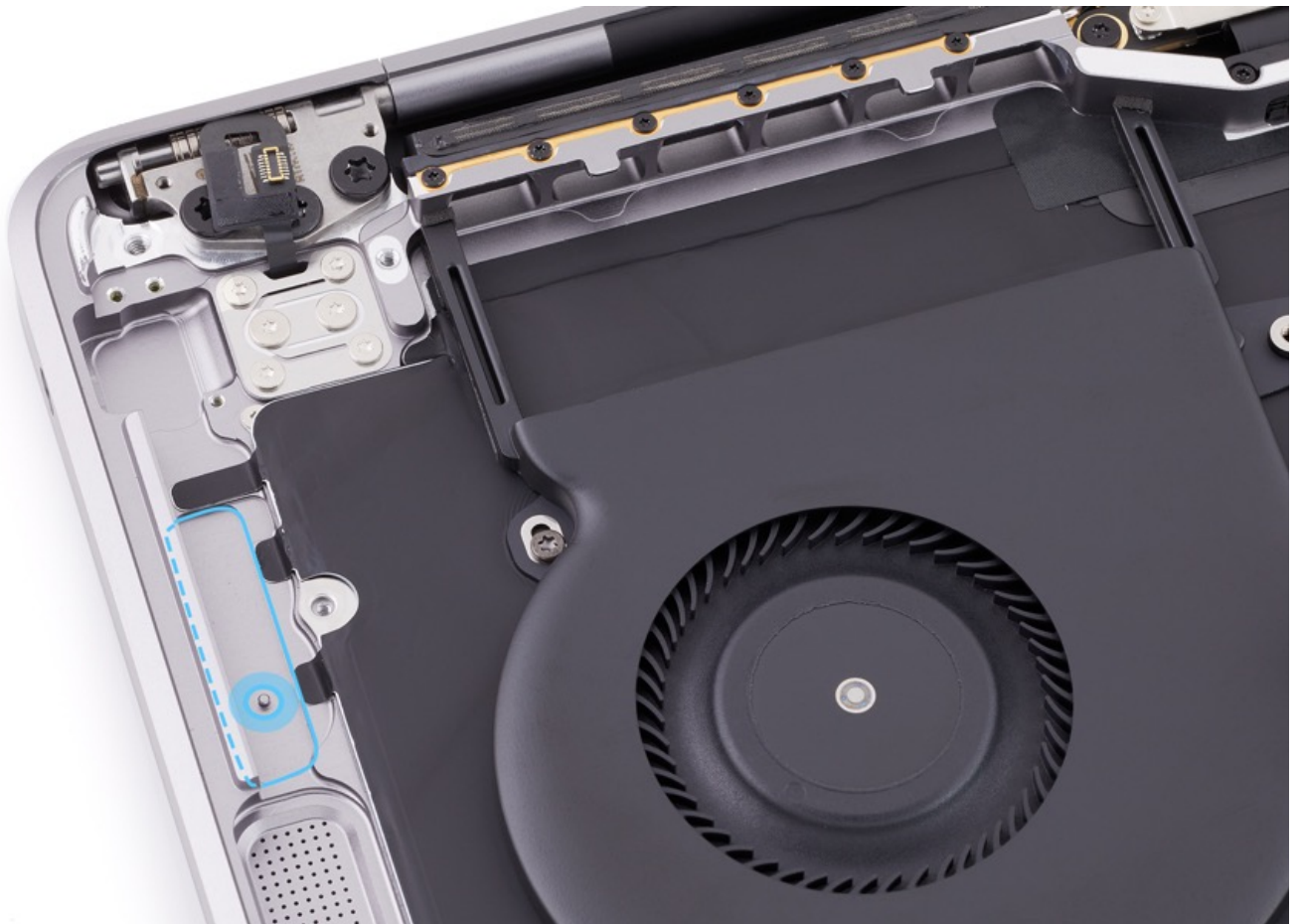


## Steps For Reassembly

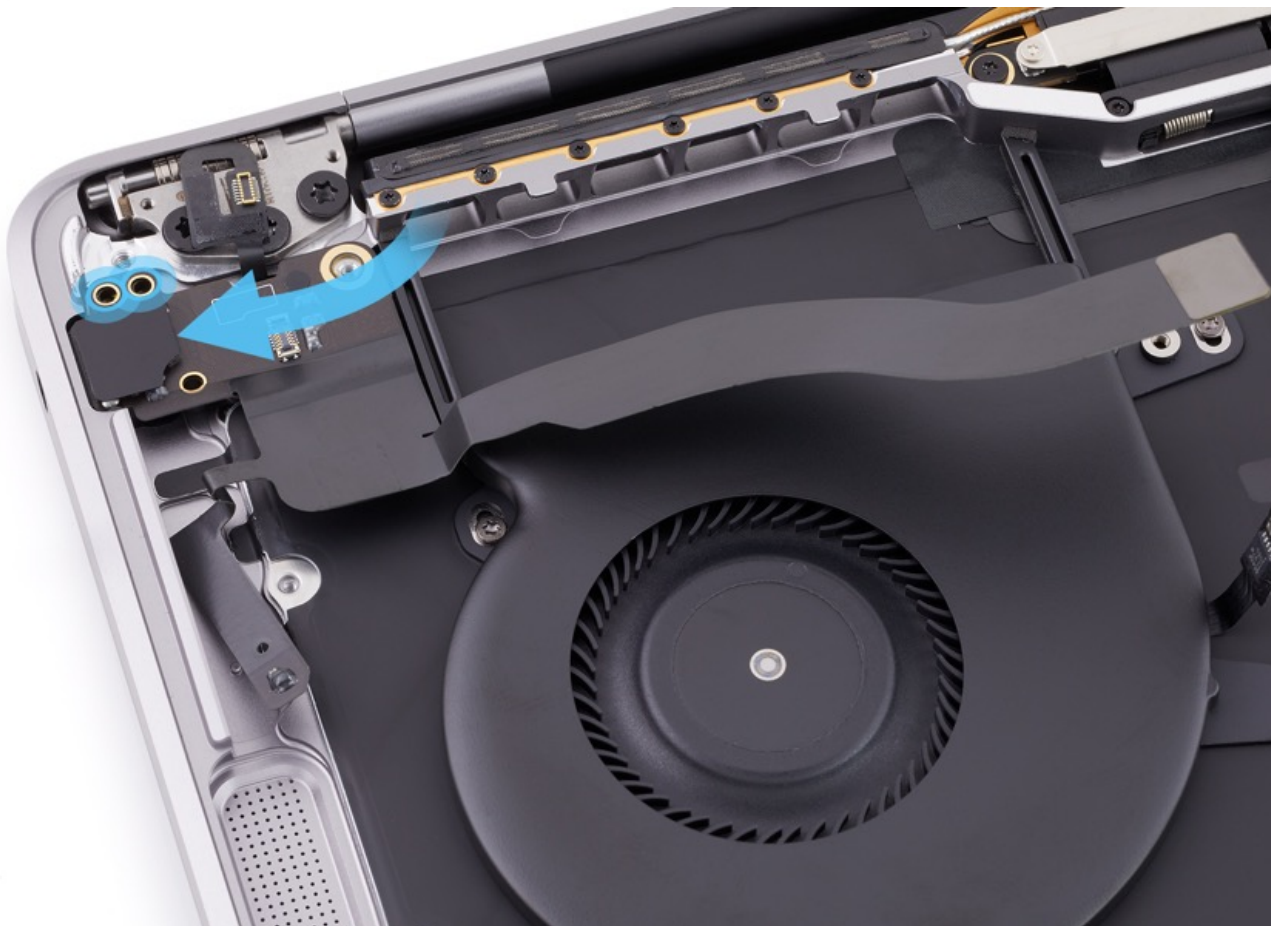


### Important:

- A new audio board flex assembly must be installed every time it is removed from the top case.
  - Be sure to order the correct part when replacing the audio board flex assembly.
    - **Space Gray:** 923-05048
    - **Silver:** 923-05049
1. Clean any residual adhesive from the fan and top case with a black stick. Note the Hall effect cable alignment pin in the top case.

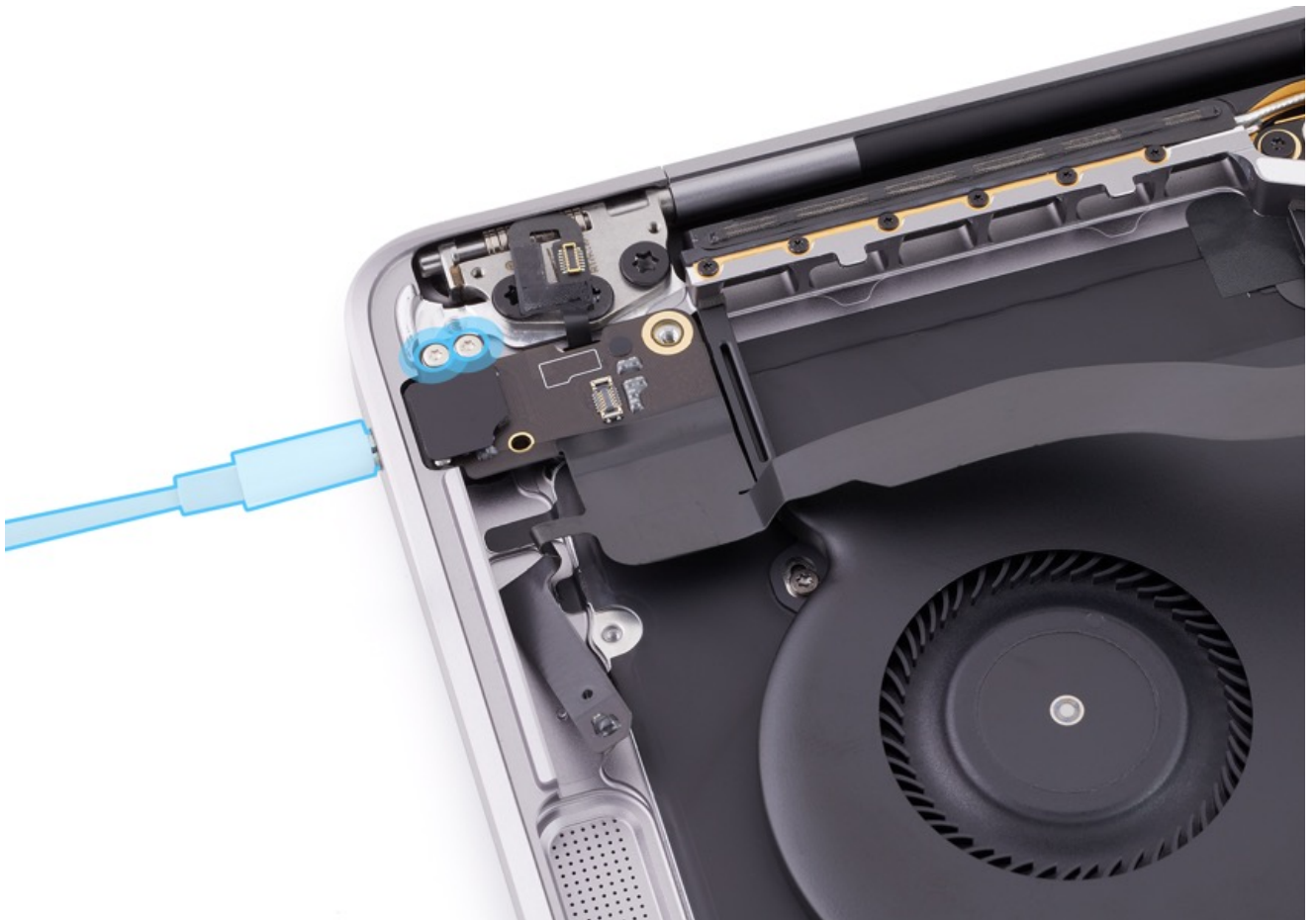


2. Reinstall the audio board flex assembly into the top case. Partially reinstall the two T3 screws (923-05242).



3. Plug in a 3.5 mm headphone jack to check alignment. Once confirmed, tighten the T3 screws, then remove the 3.5 mm headphone jack.





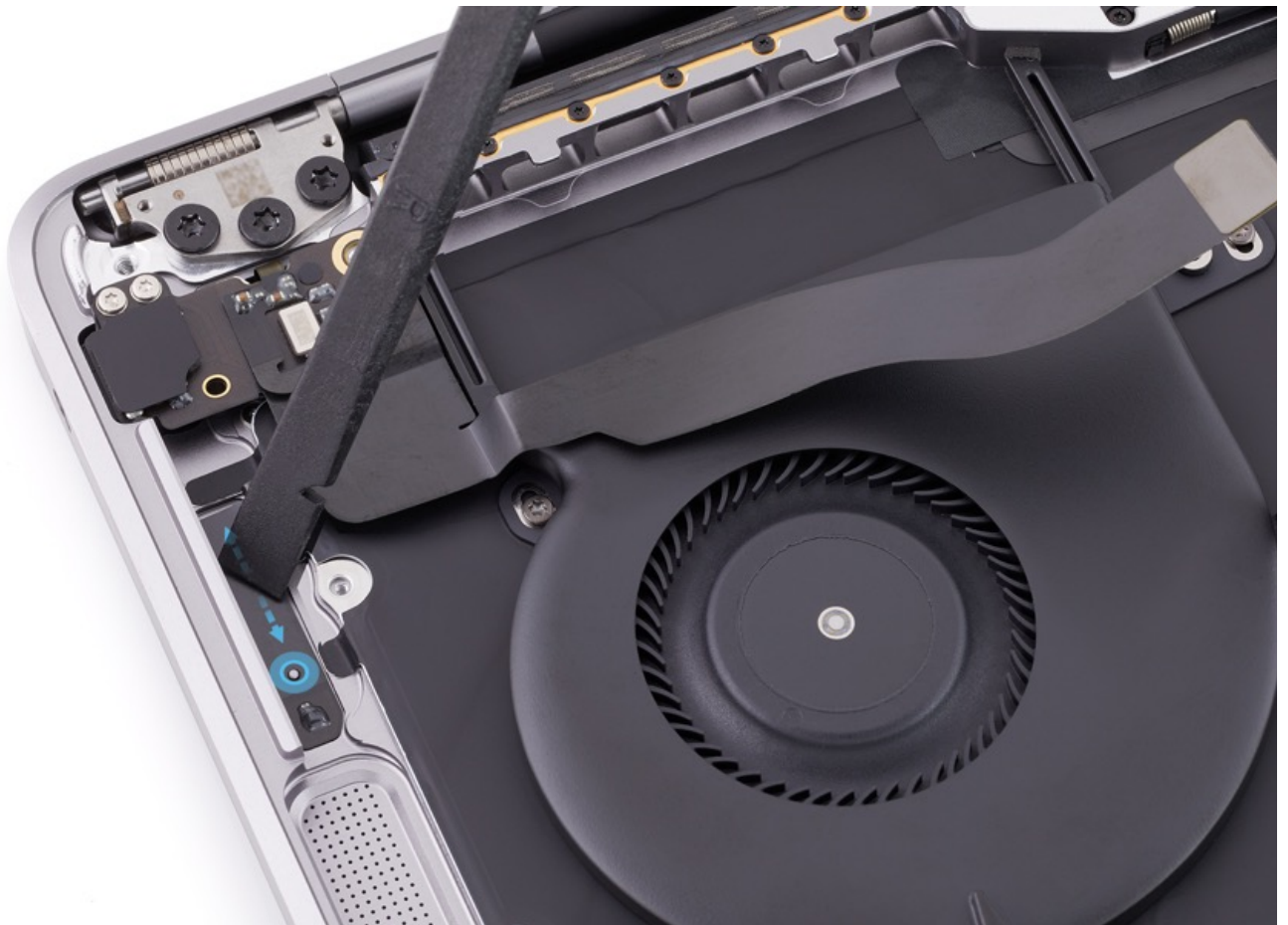
4. Replace the [Touch ID board flex cable adhesive](#) (RP1705). Connect the Touch ID board flex cable and adhere the flex cable to the audio board flex assembly.



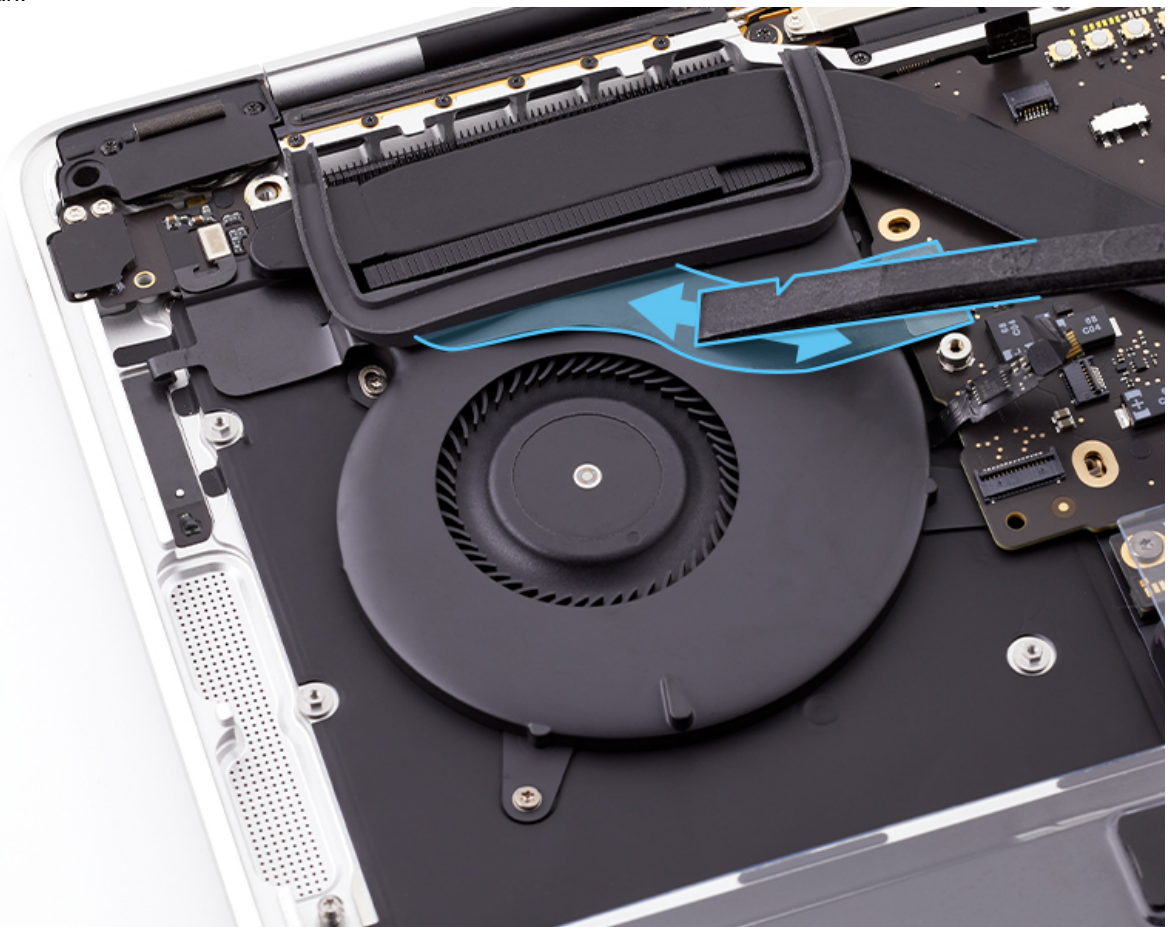
5. Peel the blue adhesive cover strip from the Hall effect sensor cable. Align the hole in the Hall effect sensor cable with the alignment pin in the top case. Gently run the flat end of a black stick along the length of the Hall effect sensor cable to adhere it to the top case.

**Caution:** Do not bend or crimp the Hall effect sensor cable. Stop at the alignment pin.





6. Reinstall the [Logic Board](#) (RP1695). Peel off the blue adhesive cover strip from the audio board flex assembly cable and adhere it to the fan. Gently press on the top of the audio board flex cable assembly from right to left to adhere the cable to the fan.



7. Reinstall right [speaker](#).
8. Reinstall right [clutch cover](#).
9. [Reconnect the battery and remove the battery cover](#).
10. Reinstall the [bottom case](#).

**Important:**

11. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# MacBook Pro (13-inch, M1, 2020) Touch ID Board

## First Steps



### Caution:

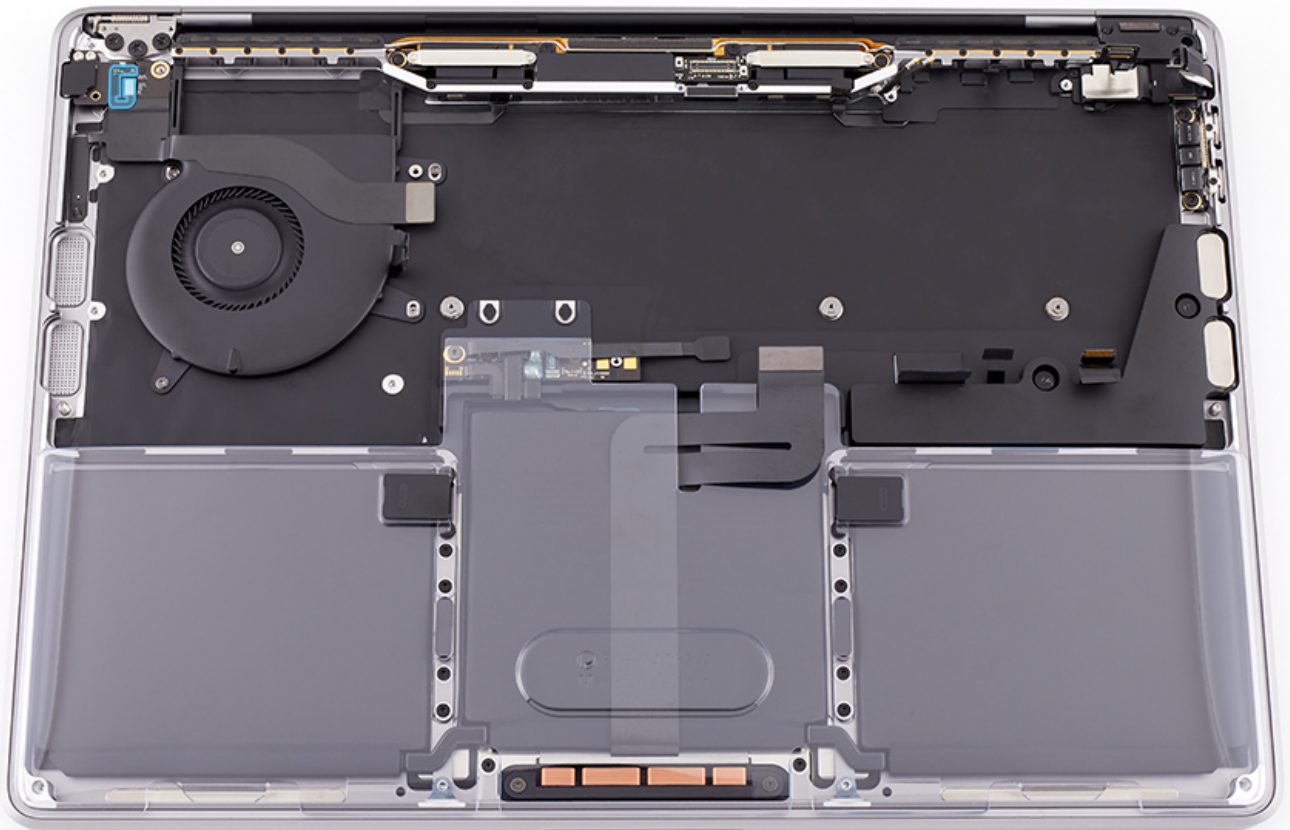
- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, you must [attach the battery cover and disconnect the battery](#) (RP1693).
- Don't connect the computer to any external power source during repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### System Configuration:

- **Important:** Completing the [System Configuration Suite](#) (TP1901) is required for the [display](#), [logic board](#), [top case](#), and [Touch ID board](#) procedures. Run the System Configuration suite to configure the Touch ID board with the computer.
- If you replace the [logic board](#), you must also replace the Touch ID board. But if you reinstall the same logic board, you don't need to replace the Touch ID board.

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)
- [Logic Board](#)
- [Clutch Covers](#) (right only)
- [Speakers](#) (right only)



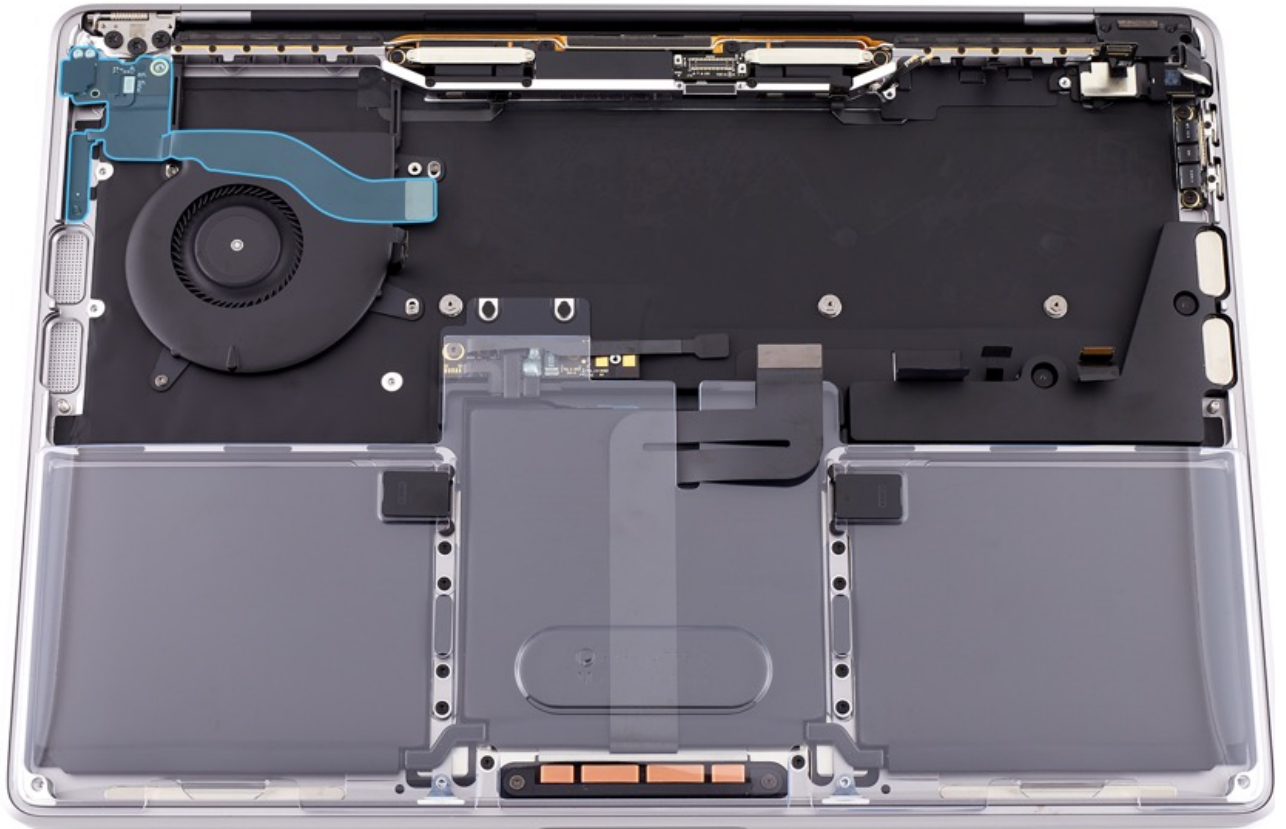
## Tools

1. Touch ID alignment kit (923-03032)
2. Torx T3 screwdriver
3. Black stick
4. ESD-safe tweezers
5. Kapton tape



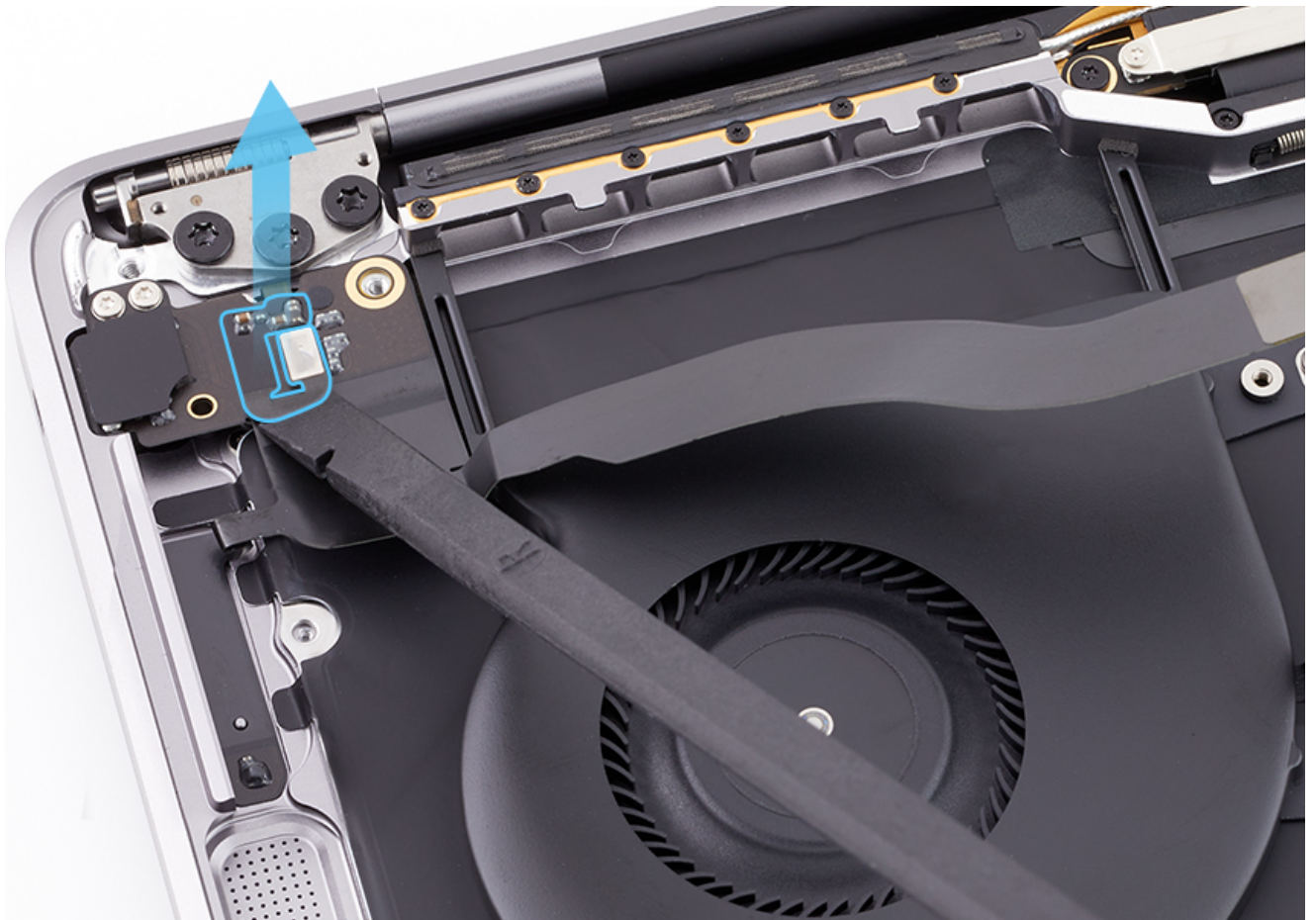
## Steps For Removal

1. To access the Touch ID board, you must partially remove the audio board flex assembly as shown in steps 2 through 5.

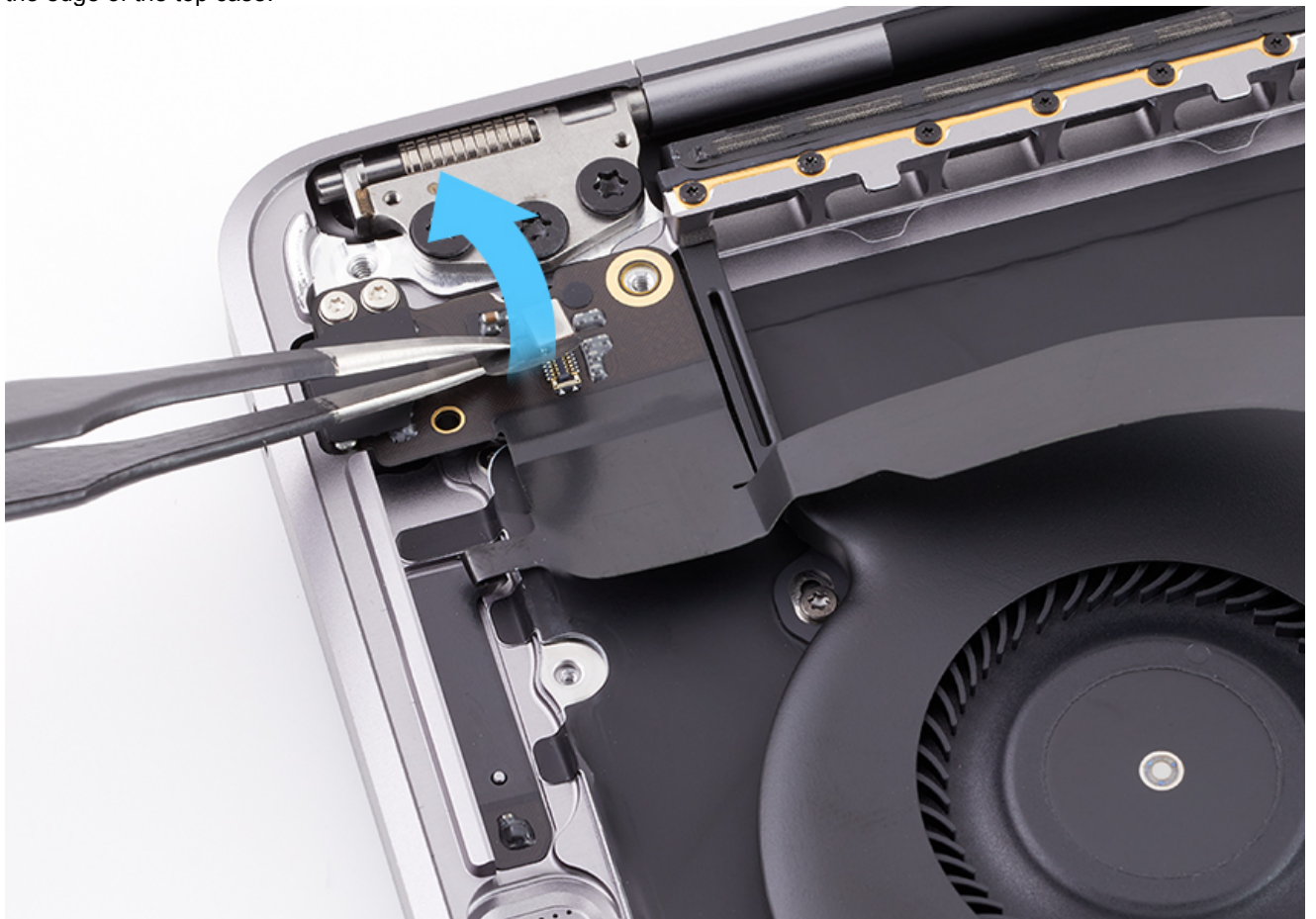


2. Gently peel back the audio flex cable and disconnect the Touch ID board flex cable from the audio board flex assembly.



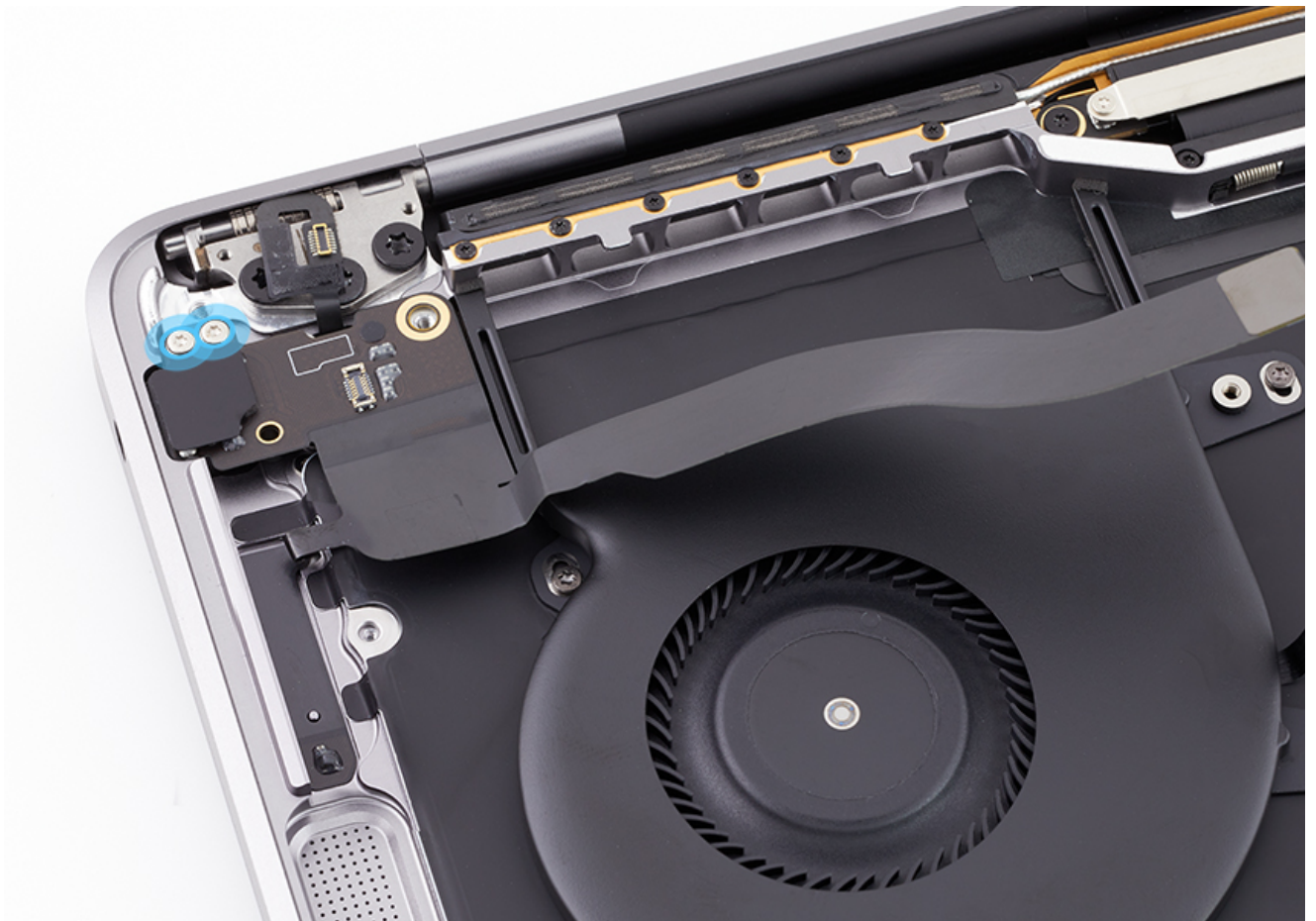


3. Use ESD-safe tweezers to loosen the adhesive on the Touch ID board flex cable. Carefully tuck the flex cable under the edge of the top case.



4. Remove two T3 screws from the audio board flex assembly.



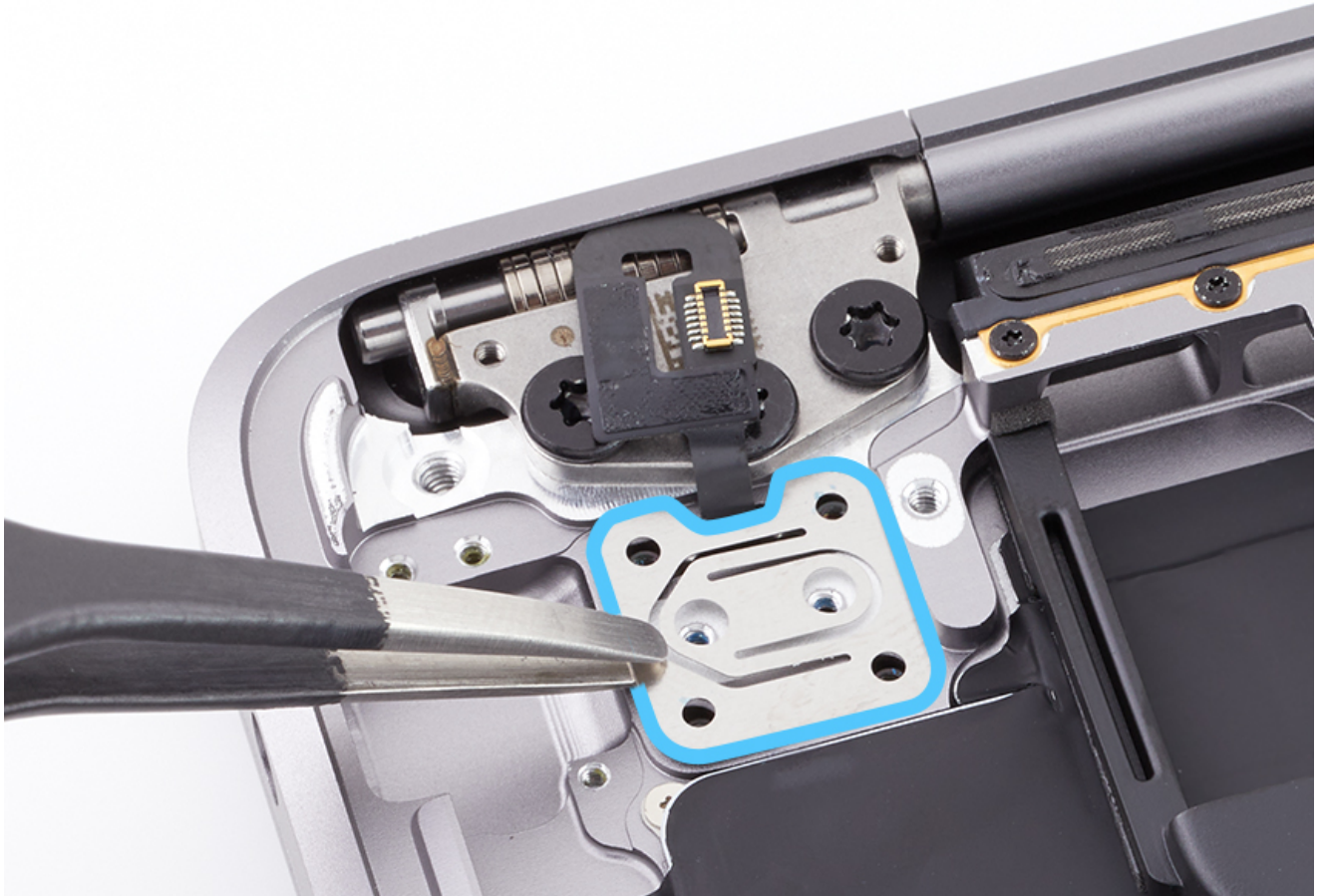


5. Lift the audio board flex assembly out of the way just enough to access the Touch ID board flexure and screws. Don't bend or crimp the flex cables adhered to the top case.
6. Remove six T3 screws from the Touch ID board flexure.

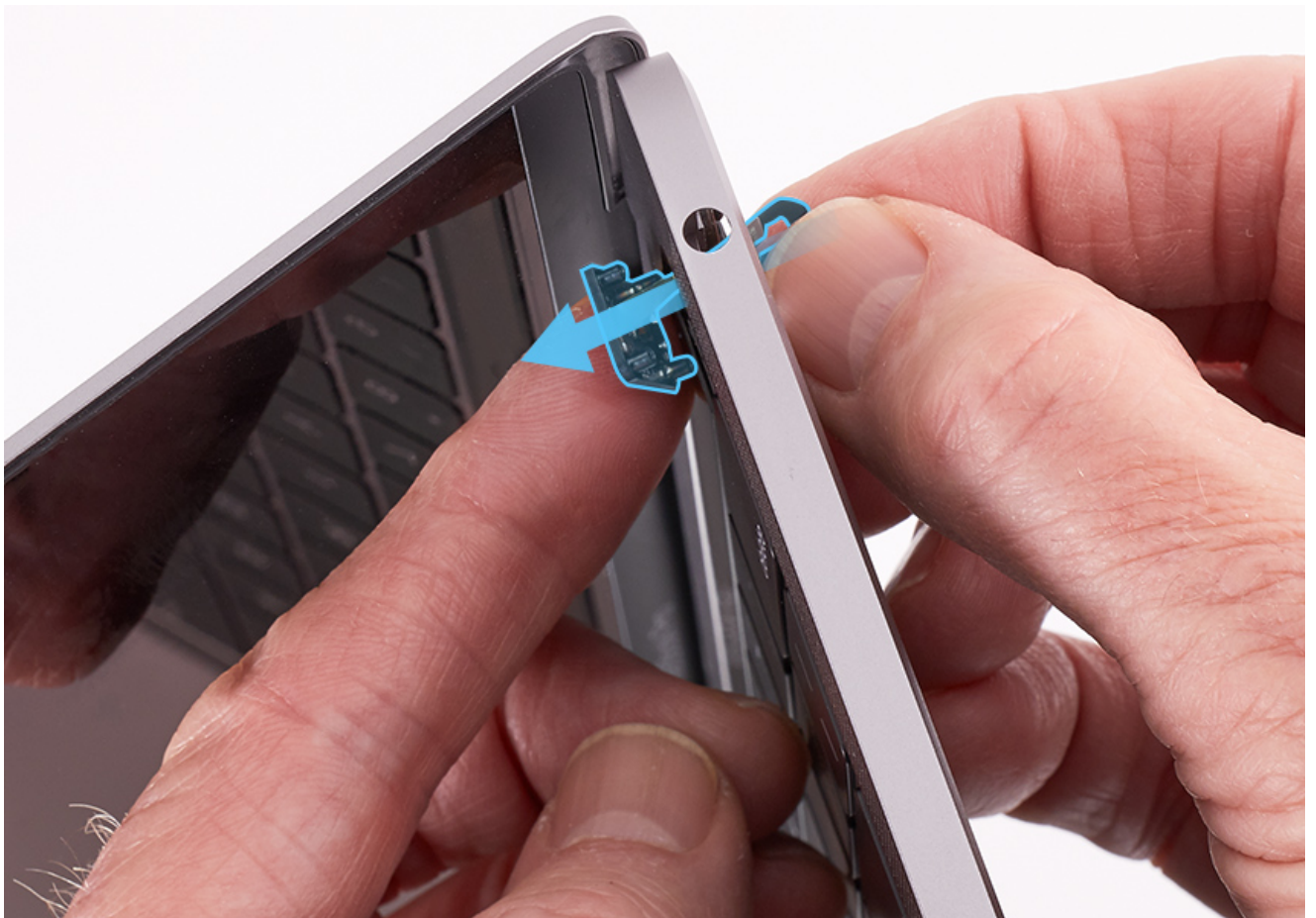


7. Use ESD-safe tweezers to remove the Touch ID board flexure from the top case.





8. Open the display and stand the computer on its side. With a hand on each side of the top case, support the Touch ID board as you thread the flex cable through the slot. Remove the Touch ID board from the keyboard side of the top case.



### Steps For Reassembly

**Note:** If you are installing a replacement Touch ID board, remove the protective film from the glass surface.



1. Place the computer flat on the ESD mat. Set two Y-shaped alignment tools in the Touch ID opening as shown. Secure the alignment tools with Kapton tape.

**Caution:** Don't damage parts in the top case that aren't fully installed.



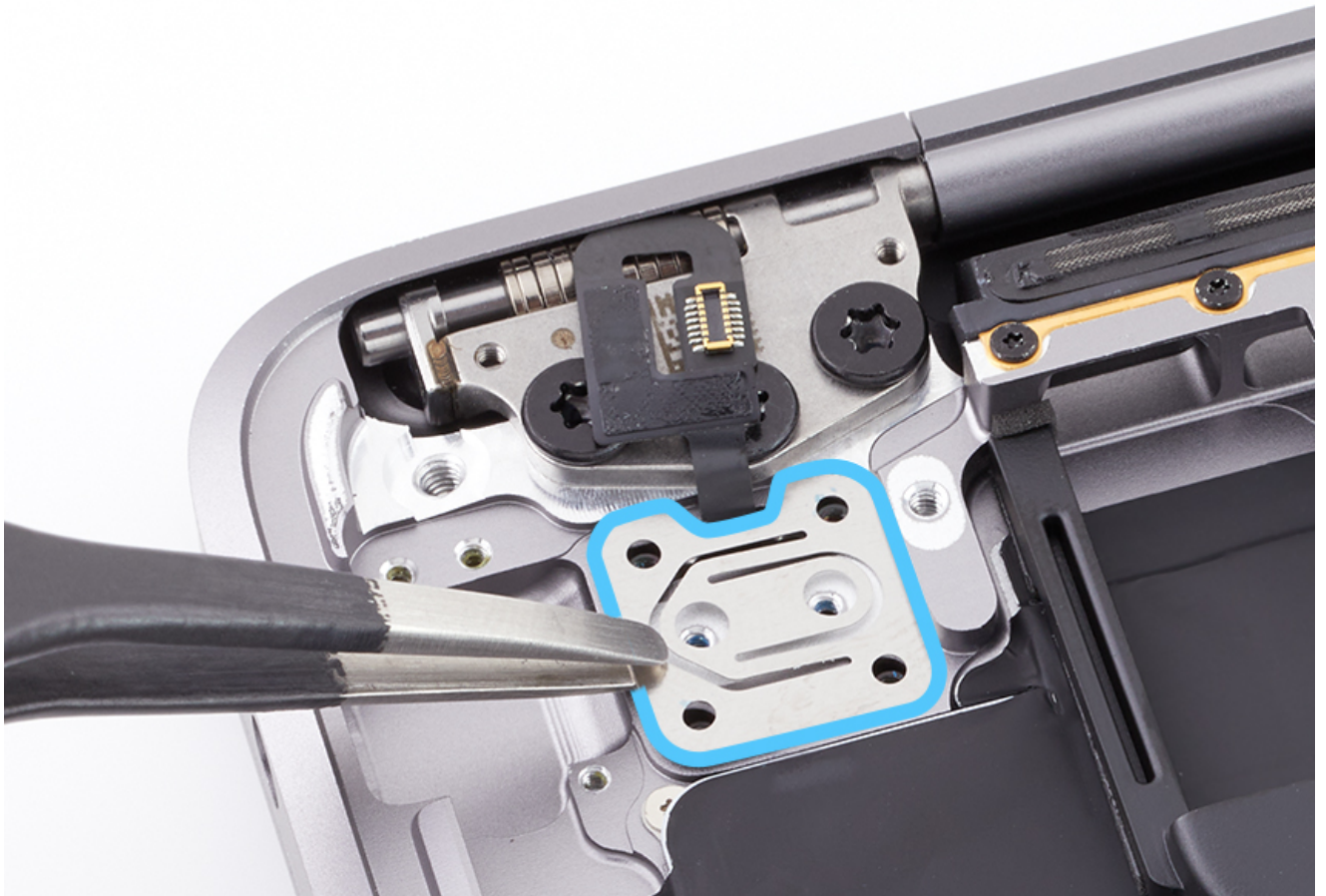
2. Open the display and stand the computer on its side. Thread the Touch ID board flex cable through the opening in the top case.





3. Use ESD-safe tweezers to reinstall the Touch ID board flexure.

**Important:** Ensure that it's installed in the correct orientation or the button may not function properly.



4. Hold the Touch ID board flexure in place while reinstalling the four outer T3 screws (1). Then partially reinstall the two middle T3 screws (2).

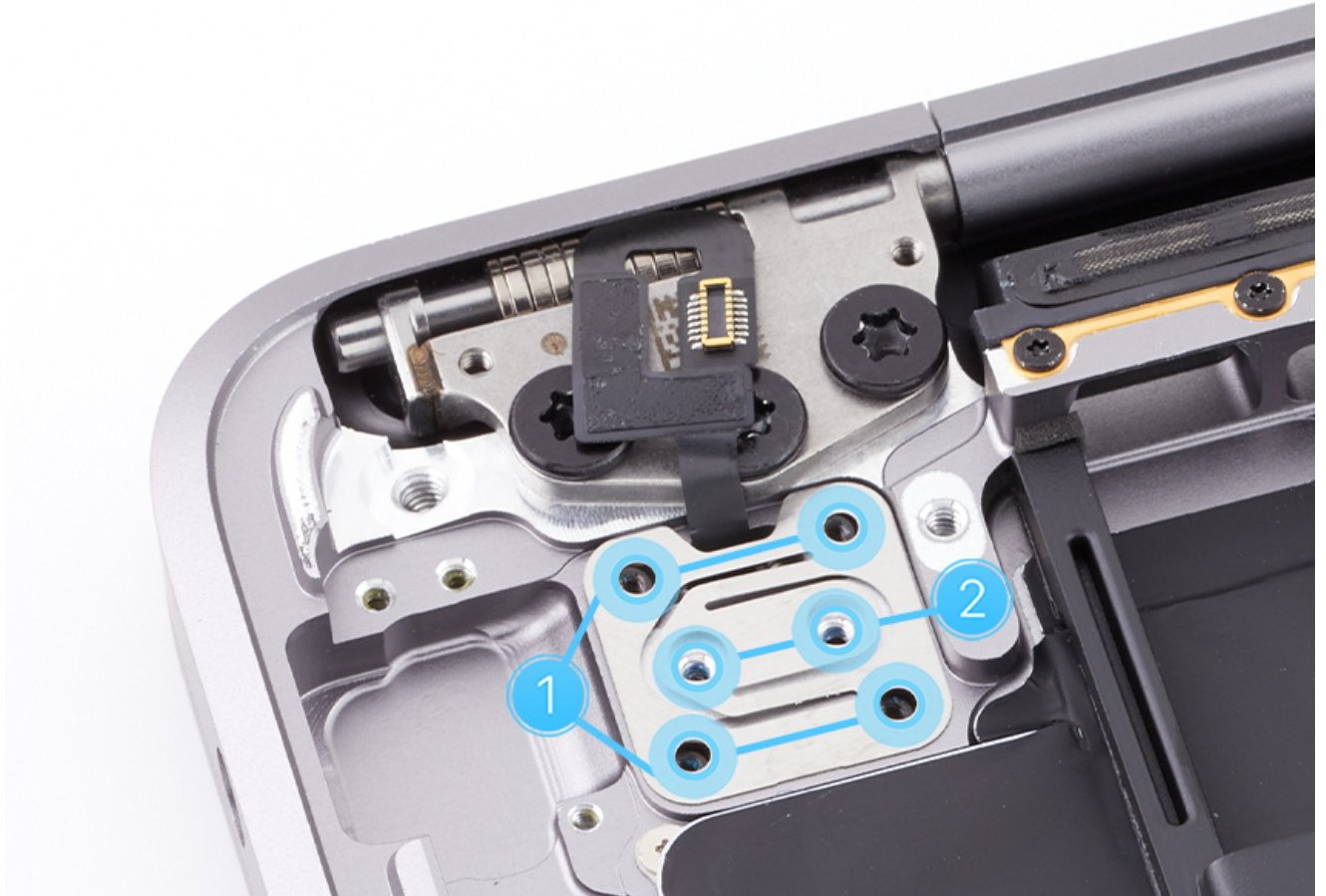
**Note:** Screw color may vary.

1. 923-05264 (outer)

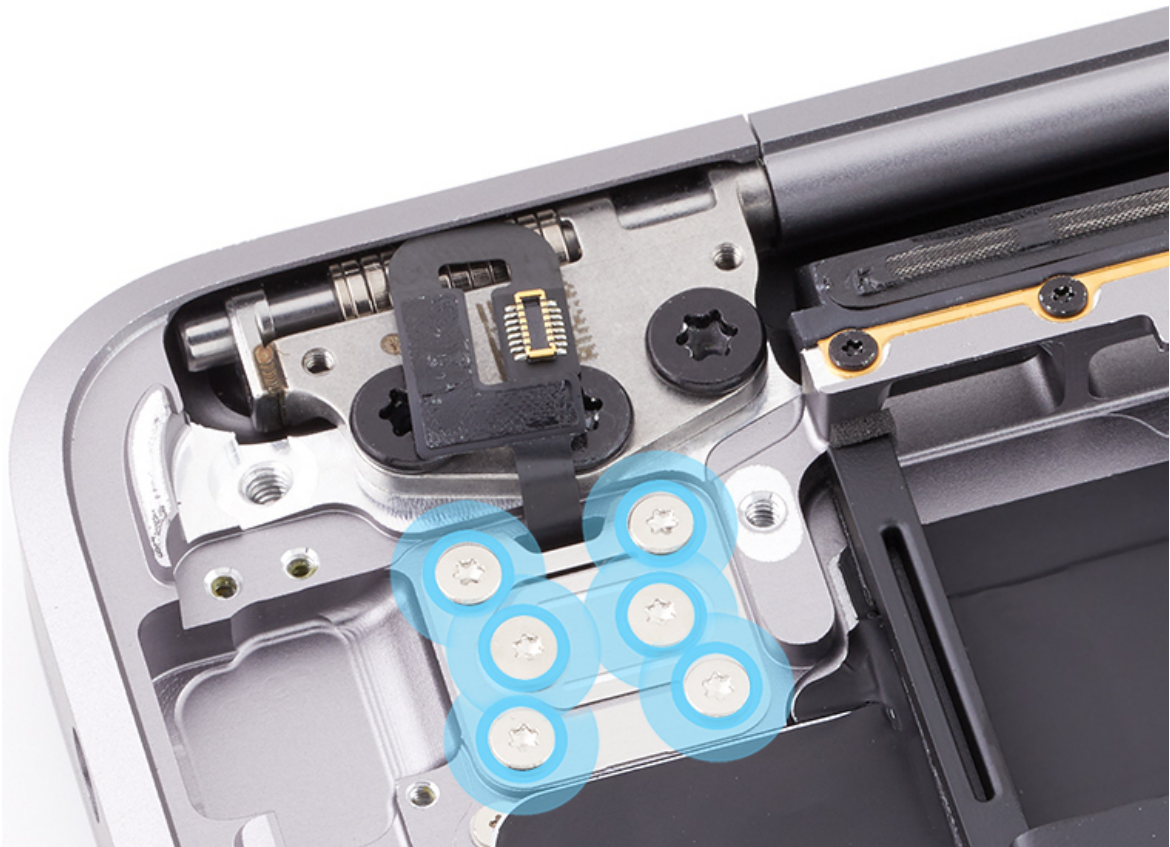




2. 923-05265 (middle)



5. Press the Touch ID button to verify that it makes a clicking noise. Fully tighten the two middle screws while continuing to verify that the Touch ID button makes a clicking noise when pressed. If the button doesn't move at all or moves but doesn't click, you may need to install a [Touch ID shim](#) (RP1352).

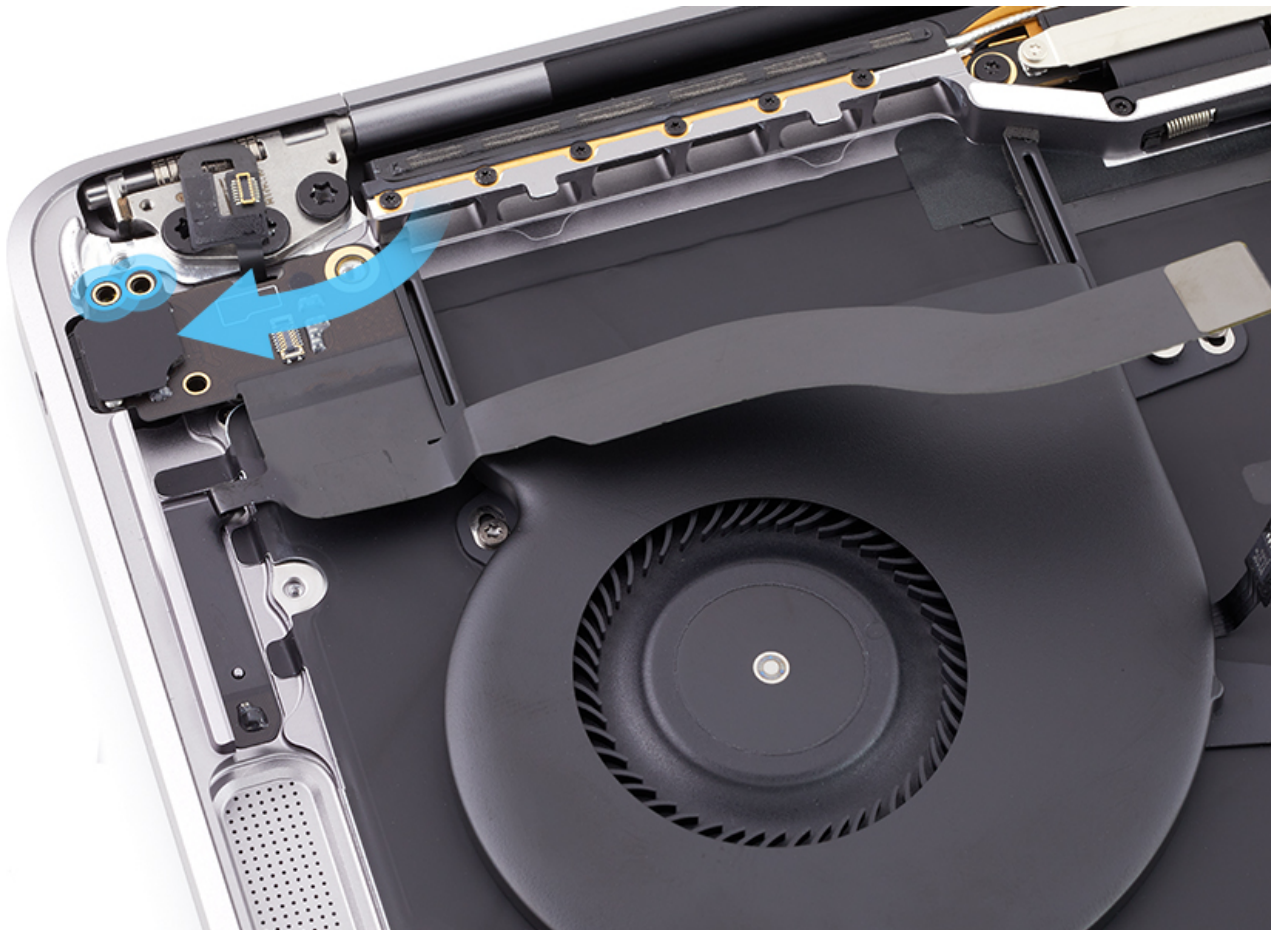


6. Remove the Y-shaped alignment tools and look at the Touch ID button to verify that all the sides are spaced equally. If not, restart the alignment process with step 1.

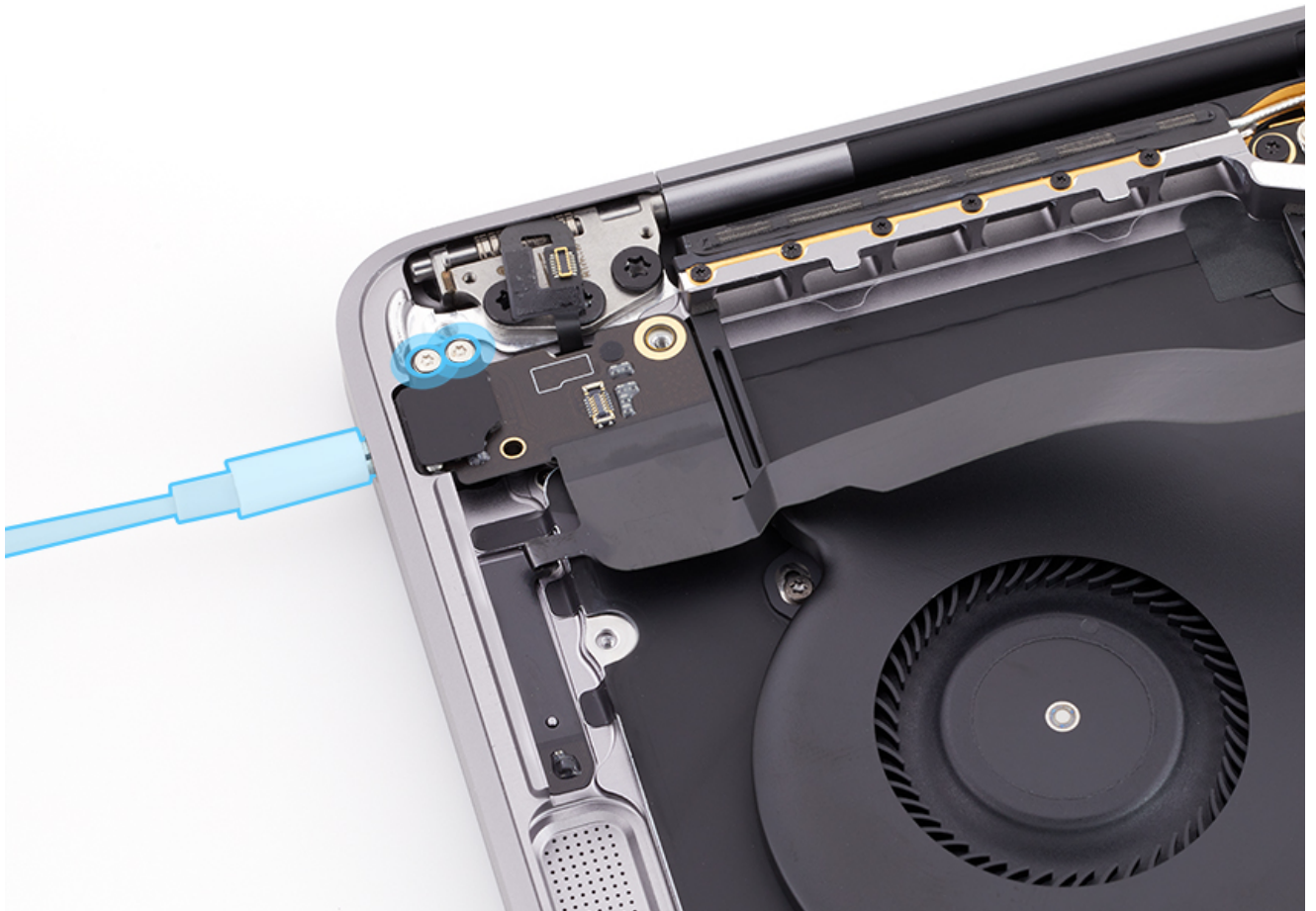


7. Reinstall the audio board flex assembly into the top case.





8. Partially reinstall the two T3 screws (923-05242). Plug in a 3.5 mm headphone jack to check alignment. Then fully tighten the T3 screws and remove the 3.5 mm headphone jack.



9. Replace the [Touch ID board flex cable adhesive](#) (RP1705). Connect the Touch ID board flex cable and adhere the flex

cable to the audio board flex assembly.



10. Reinstall the [logic board](#).
11. Reinstall the [right clutch cover](#).
12. [Reconnect the battery and remove the battery cover](#).
13. Reinstall the [bottom case](#).

**Important:**

14. Run the [System Configuration suite](#) (TP1901) to configure the Touch ID board with the computer. Completing the System Configuration suite is required for the [display](#), [logic board](#), [top case](#), and [Touch ID board](#) procedures
15. Run the appropriate [post-repair diagnostic suites](#) (TP1909).



# MacBook Air (Retina, 13-inch, 2018-2020), MacBook Air (M1, 2020), MacBook Pro (13-inch, 2019 and 2020, Two Thunderbolt 3 Ports), MacBook Pro (13-inch, 2016-2020, Four Thunderbolt 3 Ports), and MacBook Pro (13-inch, M1, 2020) Touch ID Shim

## First Steps



### Warning:

- To avoid damaging parts, you must install the battery cover and either disconnect the battery or disengage battery power to the logic board.
- Don't connect the computer to any external power source during repair.

### Important:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).
- The Touch ID alignment kit and replacement Touch ID shims are included in part boxes when Touch ID reinstallation or replacement is necessary. Learn how and when to use these parts in Touch ID reassembly steps.

**Note:** The images shown are of MacBook Pro (13-inch, 2016, Four Thunderbolt 3 Ports), but the process is the same for MacBook Air (Retina, 13-inch, 2018, 2019, and 2020), MacBook Air (M1, 2020), MacBook Pro (13-inch, 2019 and 2020, Two Thunderbolt 3 Ports), MacBook Pro (13-inch, M1, 2020), and MacBook Pro (13-inch, 2017, 2018, 2019, 2020, Four Thunderbolt 3 Ports).



## Tools

- Torx T3 screwdriver (magnetized)
- ESD-safe tweezers

- Shim kit, package of 3 (923-01519), not shown



## Steps For Removal

**Note:** The Touch ID shim is a tiny, circular part. Ensure that your work surface is completely clean. A clean surface allows easy location of the shim if it falls on the ESD mat during repair.

1. Determine the required Touch ID shim size:

- If the button feels too loose or doesn't click, a larger shim is required.
- If the button feels too stiff or doesn't move, a smaller shim is required.



2. Spread the tips of the ESD-safe tweezers, and use one tip to push the shim out.





3. Retrieve the loose shim on the keyboard side of the top case. The shim has a small amount of adhesive and may stick to the top case. The shim is black on the adhesive side and silver on the opposite side.



### Steps For Reassembly

1. Replace the Touch ID shim with one of the shims from the kit (923-01519). Shims are marked and organized by size.
  - Use ESD-safe tweezers to remove the appropriate shim from the backing.
  - Hold less than half of the shim with the ESD-safe tweezer for easier installation.
2. Set the computer flat on the ESD mat.

**Important:** For MacBook Pro models, ensure that the battery cover is in position and the I/O board(s) are flat.

3. Align the shim in the recessed circle on the top case.



4. Gently press the shim to activate the adhesive.



5. Reinstall the Touch ID board for the model you're repairing:

- [MacBook Air \(M1, 2020\)](#) (RP1685)
- [MacBook Air \(Retina, 13-inch, 2020\)](#) (RP1612)
- [MacBook Air \(Retina, 13-inch, 2018 and 2019\)](#) (RP1463)



- [MacBook Pro \(13-inch, 2020, Two Thunderbolt 3 Ports\)](#) (RP1648)
- [MacBook Pro \(13-inch, 2019, Two Thunderbolt 3 Ports\)](#) (RP1529)
- [MacBook Pro \(13-inch, M1, 2020\)](#) (RP1704)
- [MacBook Pro \(13-inch, 2020, Four Thunderbolt 3 Ports\)](#) (RP1626)
- [MacBook Pro \(13-inch, 2016, 2017, 2018, 2019, Four Thunderbolt 3 Ports\)](#) (RP1346)

**Note:** Confirm that Touch ID and the power button function correctly with the new shim installed.

# MacBook Pro (13-inch, M1, 2020) Touch ID Board Flex Cable Adhesive

## First Steps

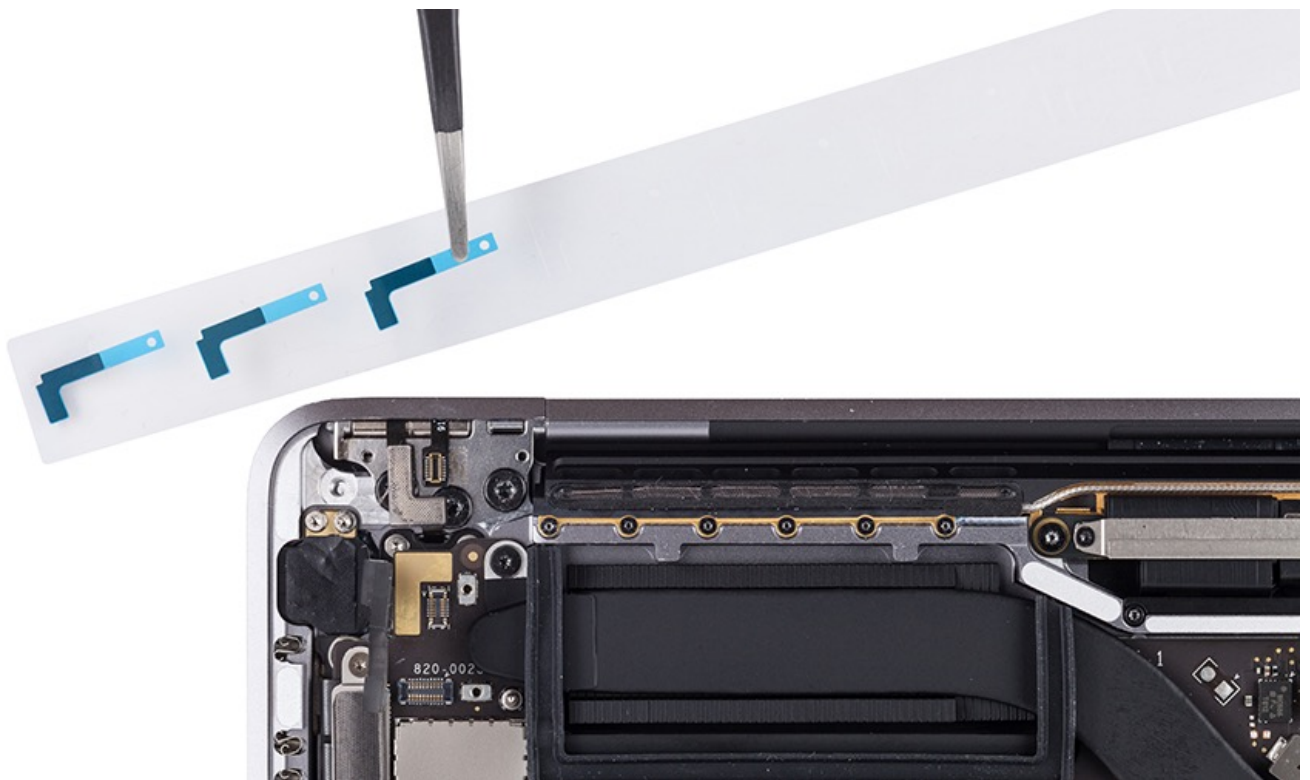


### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Important:

- New adhesive must be applied whenever the Touch ID board flex cable is disconnected.



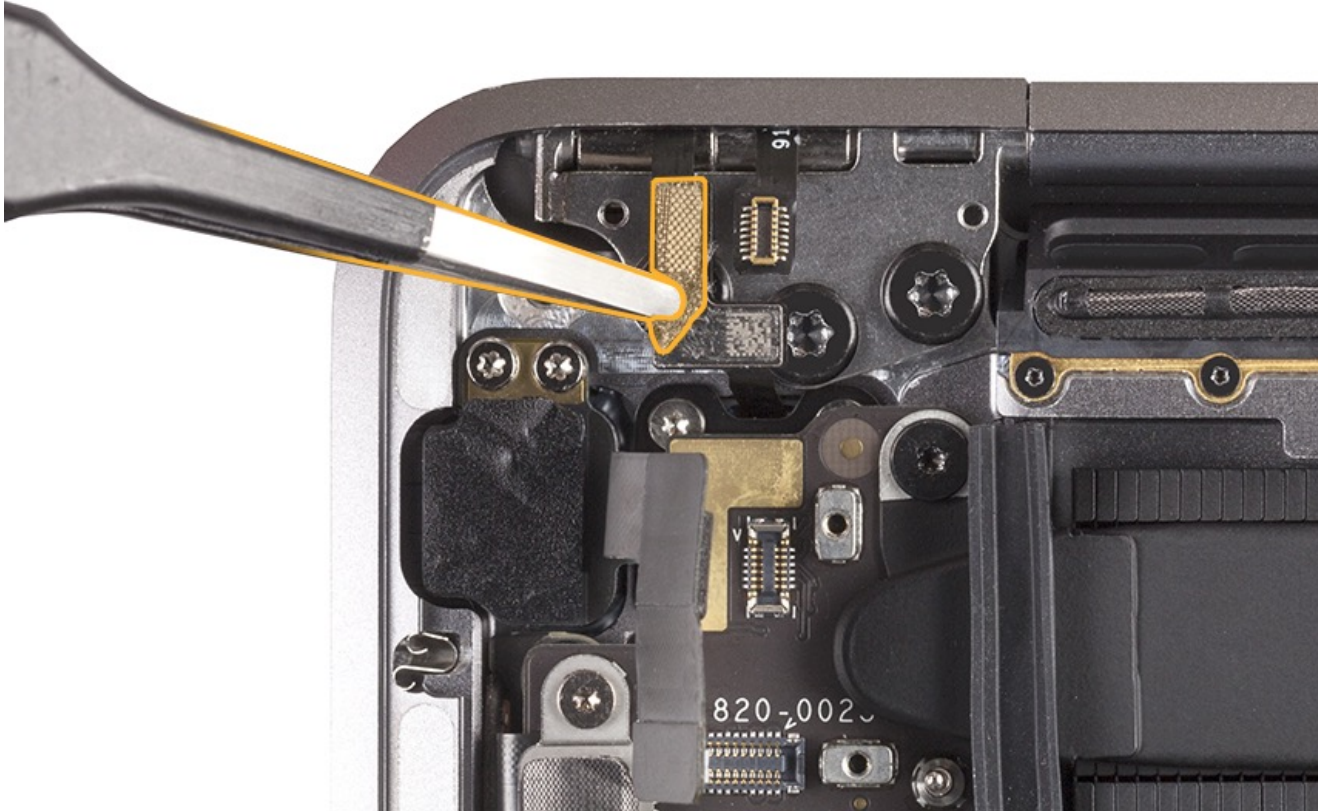
## Tools

1. Black stick
2. Torx T3 screwdriver
3. ESD-safe tweezers
4. Isopropyl alcohol (IPA) wipe

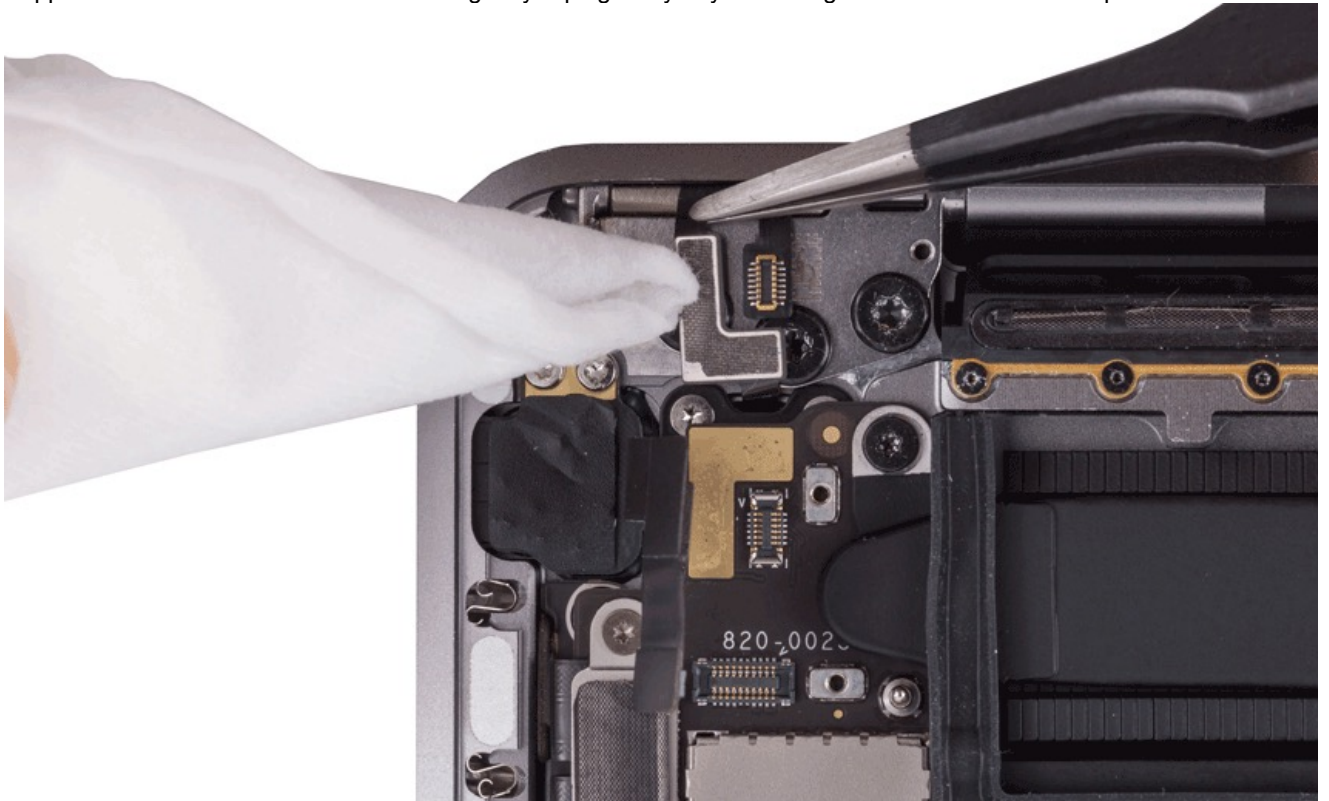


## Steps For Removal

1. Use the tweezers to gently pick up one end of the woven adhesive. Peel back and discard the used adhesive.

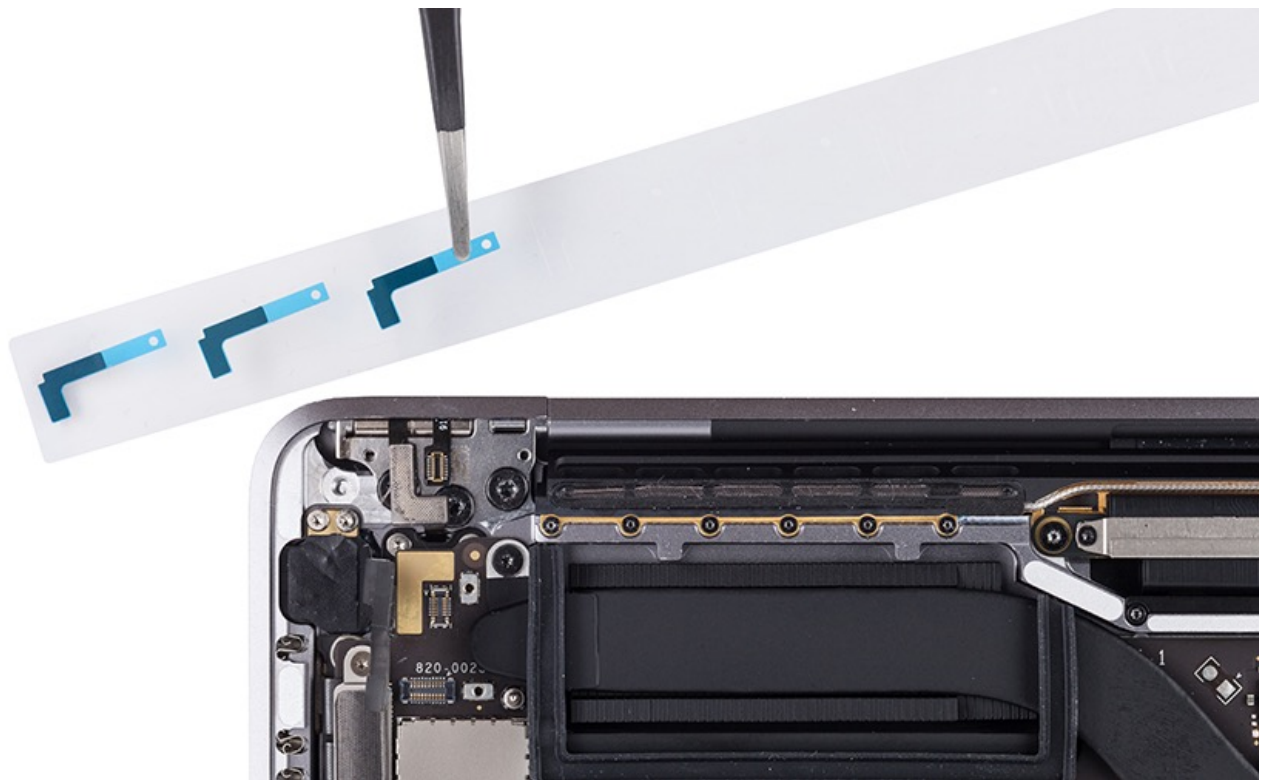


2. Support the flex cable with tweezers while gently wiping away any remaining adhesive with an IPA wipe.

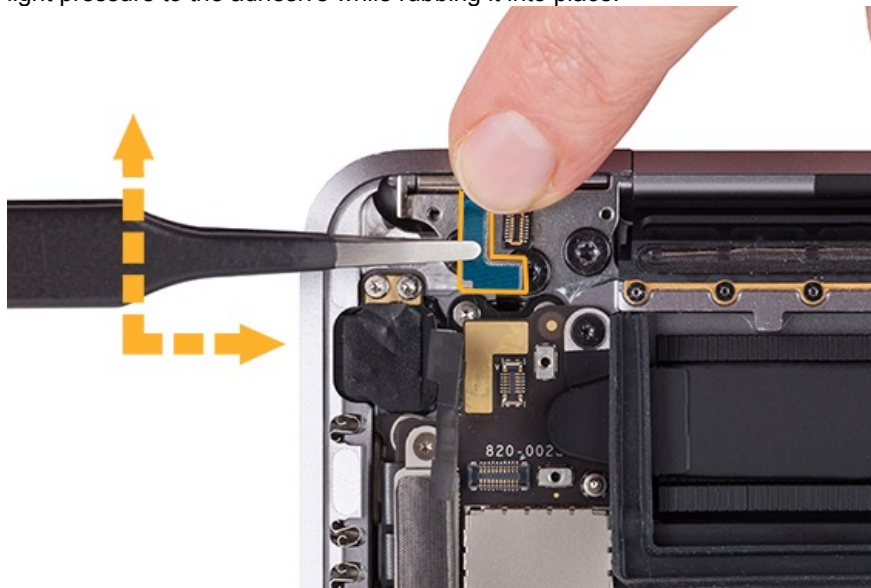


## Steps For Reassembly

1. Peel off one of the L-shaped adhesive strips that came with a replacement audio board flex assembly or Touch ID board. Grasp the light blue (nonsticky) end and remove the strip from the sheet. The L-shaped adhesive strips can also be ordered as a separate part (923-01599).

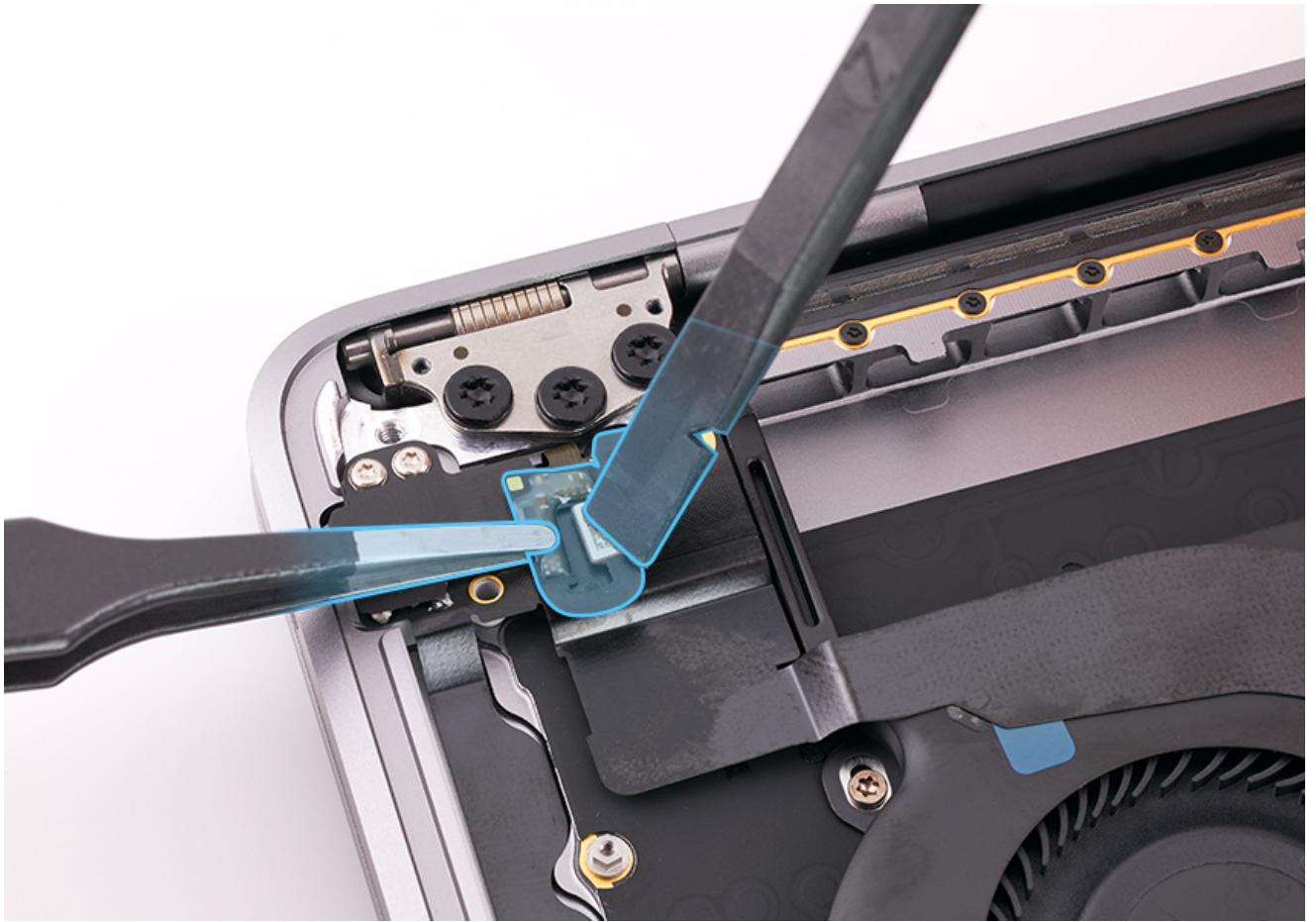


2. Align the L-shaped adhesive within the edges of the Touch ID board flex cable. Avoid crooked or overlapping adhesive. If it is off center, peel the adhesive back and realign it on the cable. Then, use the tweezers or the black stick to apply light pressure to the adhesive while rubbing it into place.



3. Slightly lift the Touch ID flex cable with tweezers to avoid the adhesive from sticking before the flex is connected. Use a black stick to reconnect the flex cable and then adhere the adhesive. If the adhesive sticks before the flex is connected, the flex may twist or break.





4. Align the flex cable over the L-shaped imprint on the audio board flex assembly.

**Important:** After reconnecting the Touch ID board flex cable, firmly press and hold the L-shaped section of the flex cable for 10 seconds.

**Important:**

5. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# MacBook Pro (13-inch, M1, 2020) Fan

## First Steps

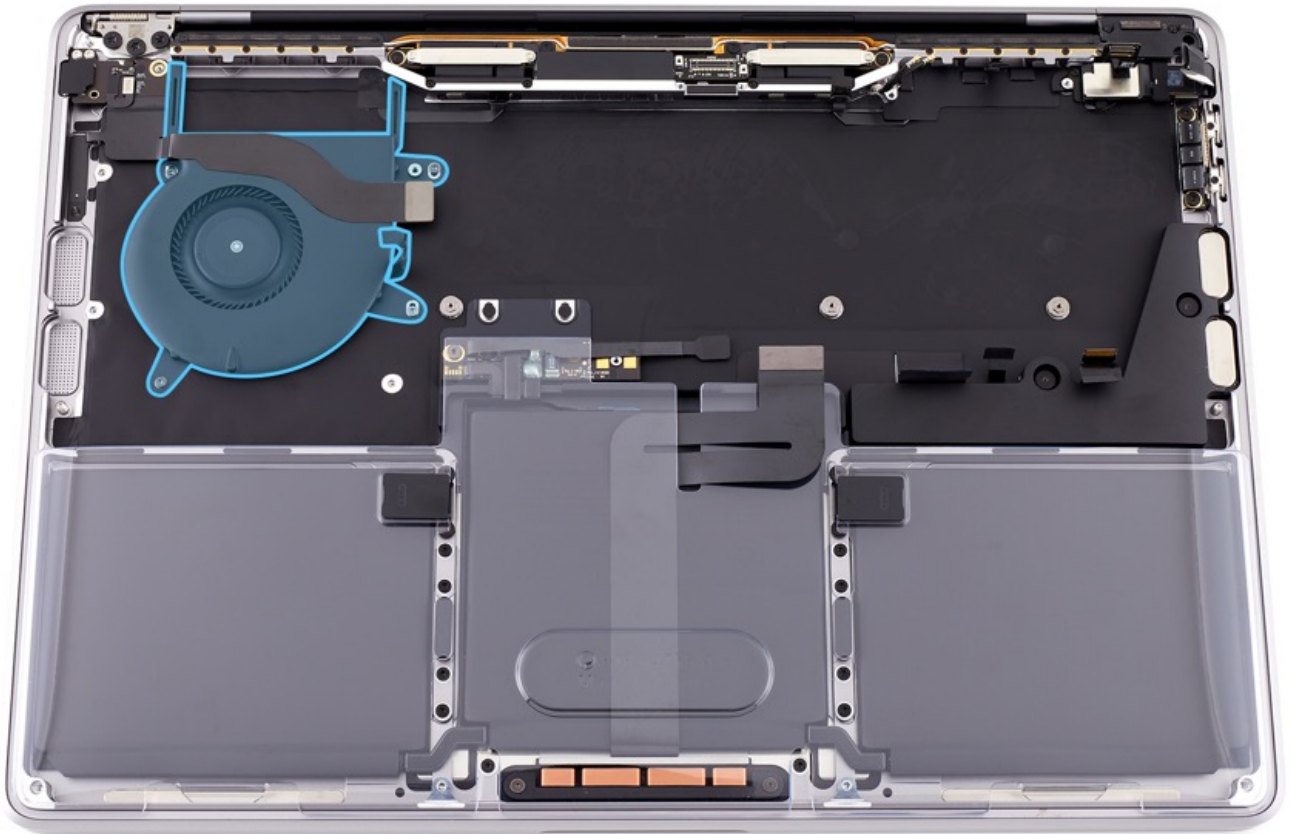


### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)
- [Logic Board](#)
- [Speaker](#) (right only)



## Tools

1. Torx T5 screwdriver
2. Black stick



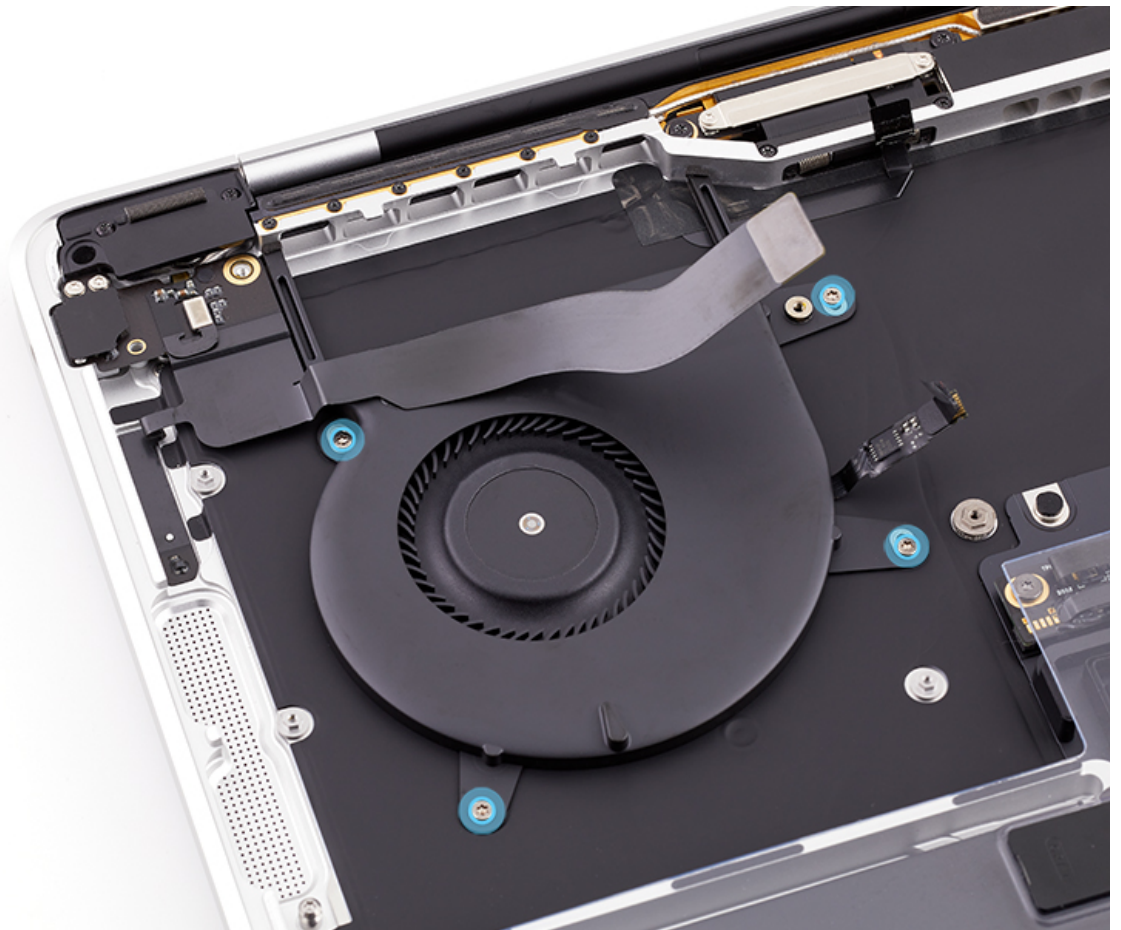
## Steps For Removal

1. The audio board flex assembly cable is adhered to the fan. Gently lift the cable to loosen the adhesive and separate the cable from the fan.

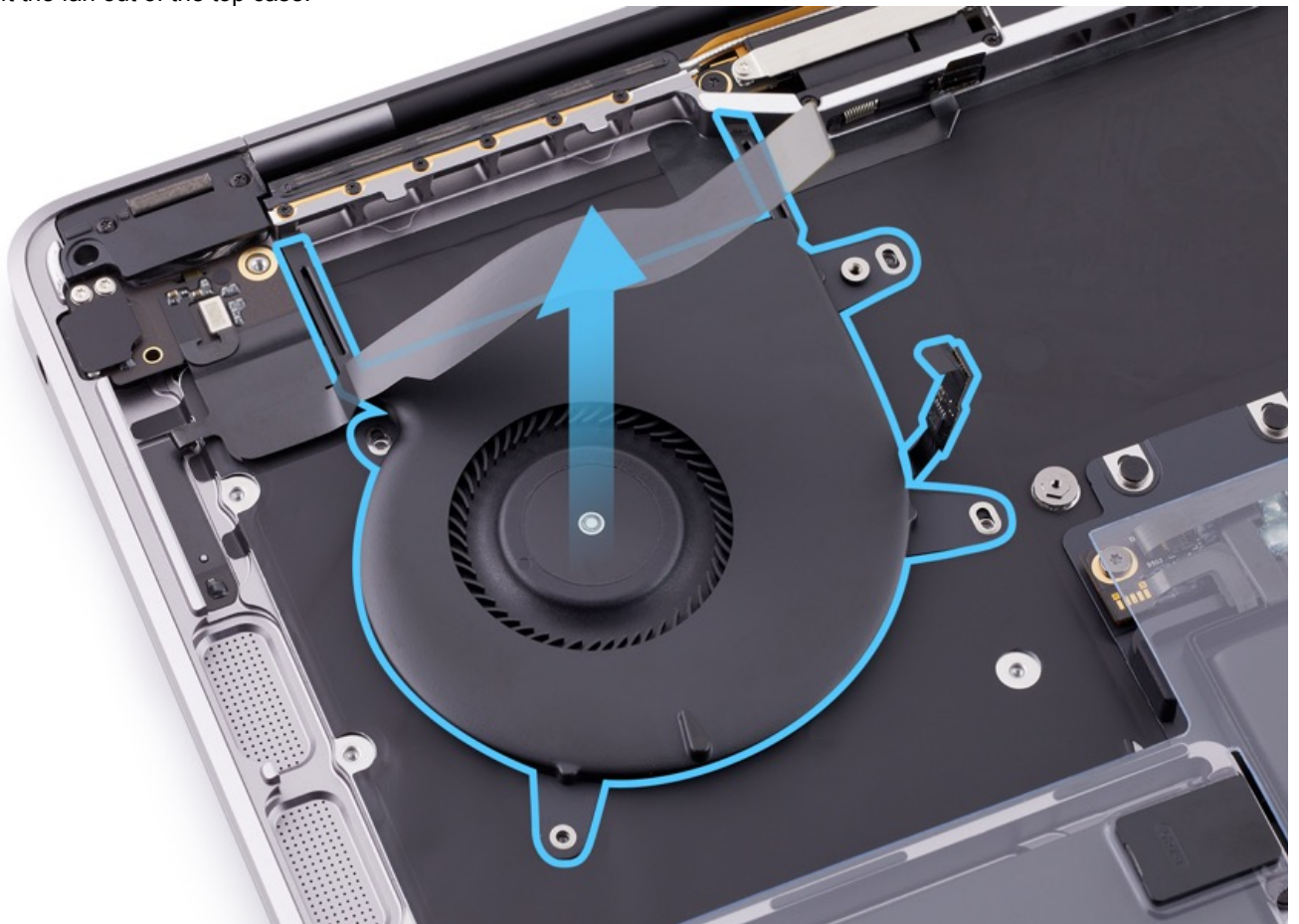


2. Remove four T5 screws from the fan.





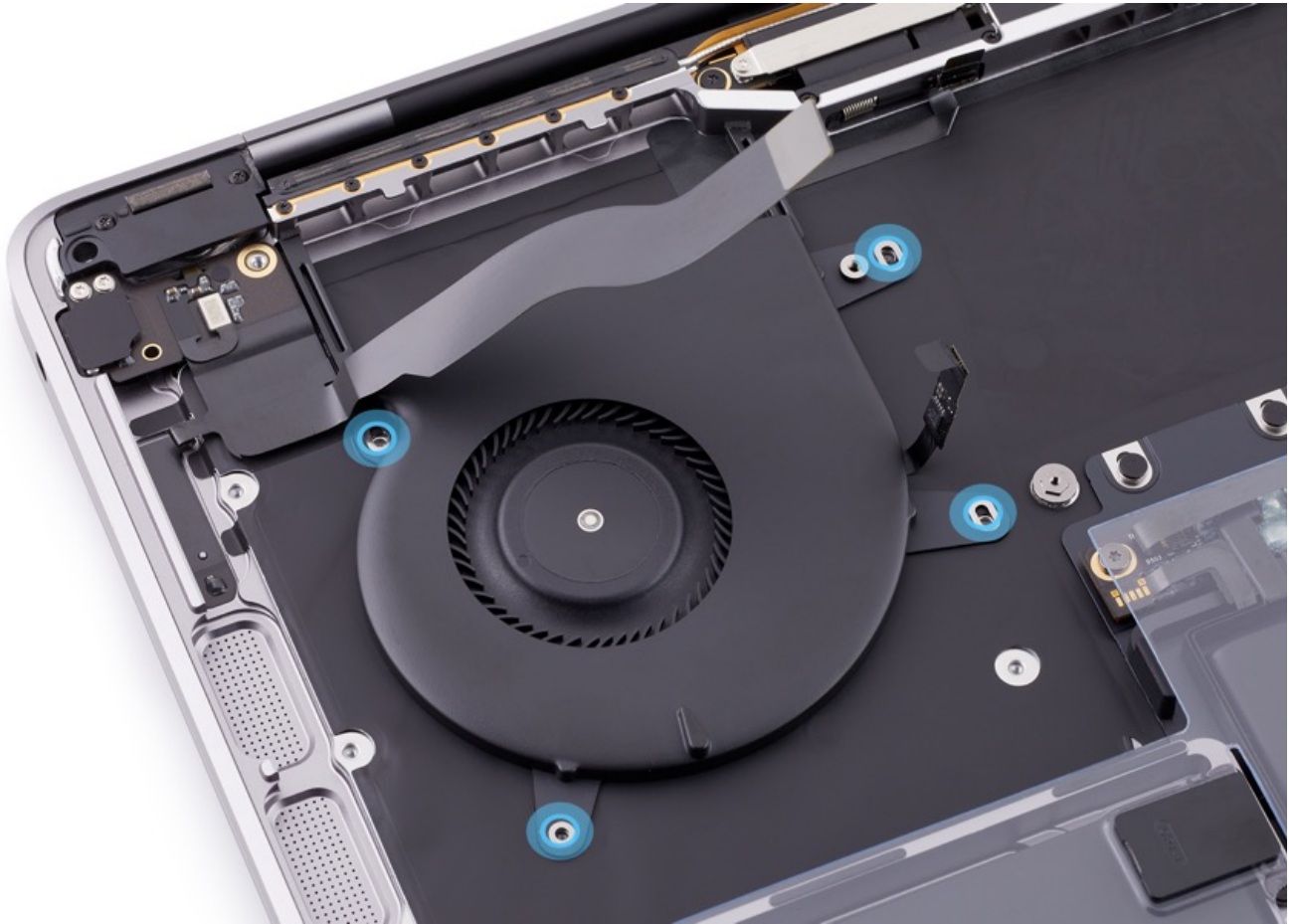
3. Lift the fan out of the top case.



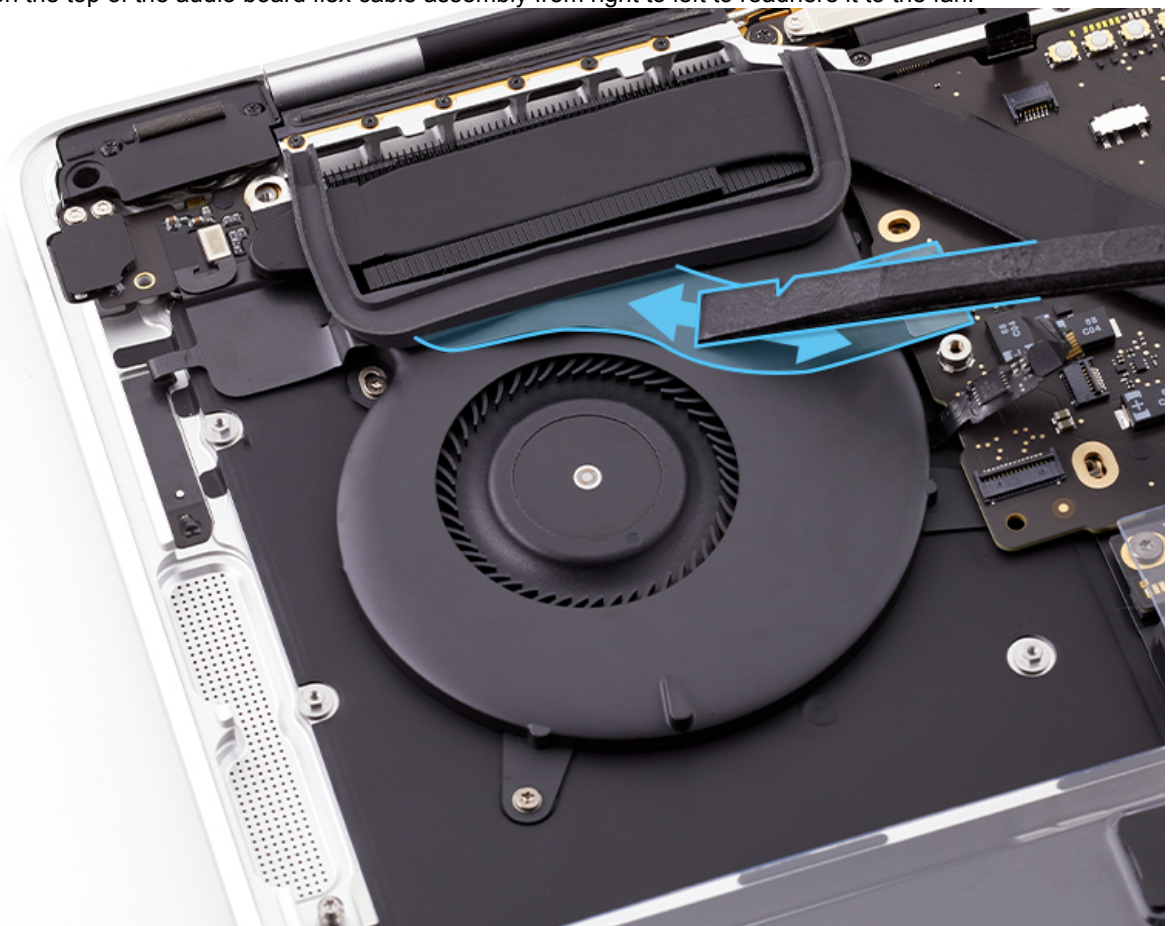
### Steps For Reassembly

1. Position the fan in the top case and reinstall four T5 screws (923-05258), installing the bottom left screw first.





2. Reinstall the [logic board](#) (RP1695) and reconnect the audio flex cable assembly. With the flat end of a black stick, gently press on the top of the audio board flex cable assembly from right to left to readhere it to the fan.



3. Reinstall the [right speaker](#).

4. [Reconnect the battery and remove the battery cover.](#)
5. Reinstall the [bottom case](#).

**Important:**

6. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# MacBook Pro (13-inch, M1, 2020) Trackpad and Flex Cable

## First Steps



### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, ensure that you have [attached the battery cover and disconnected the battery](#) (RP1693).
- Do not apply external power while the computer is under repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)



## Tools

1. 10–34 Ncm torque driver (set to 16 Ncm) (923-02995)
2. T5 security bit (923-02996)
3. Torx T5 screwdriver
4. Black stick
5. ESD-safe tweezers
6. Gap offset tools (923-02998)
7. Sticky Notes
8. Kapton tape



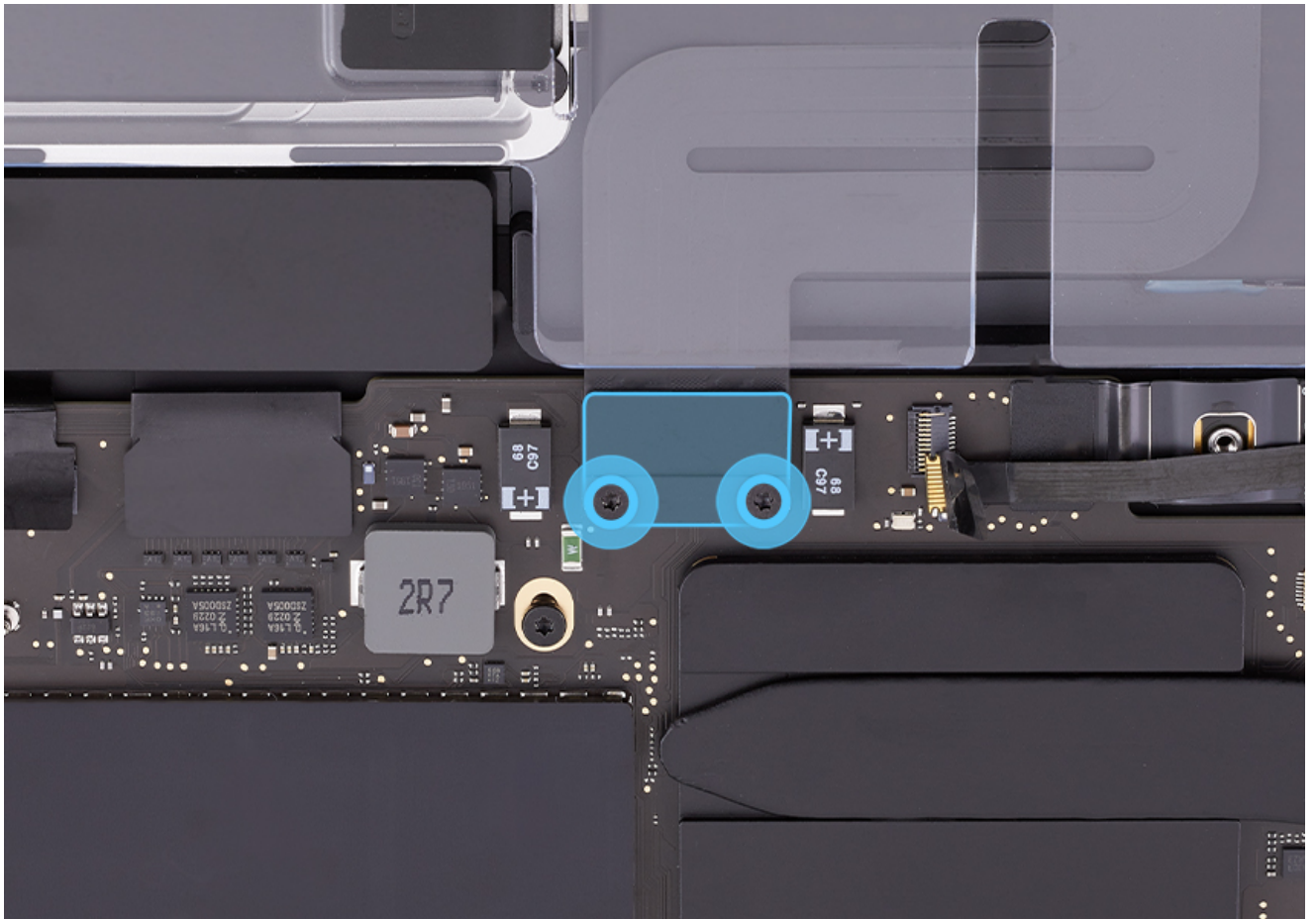
### Steps For Removal

1. Open the computer and place the top case near the edge of the table with the display over the table edge.

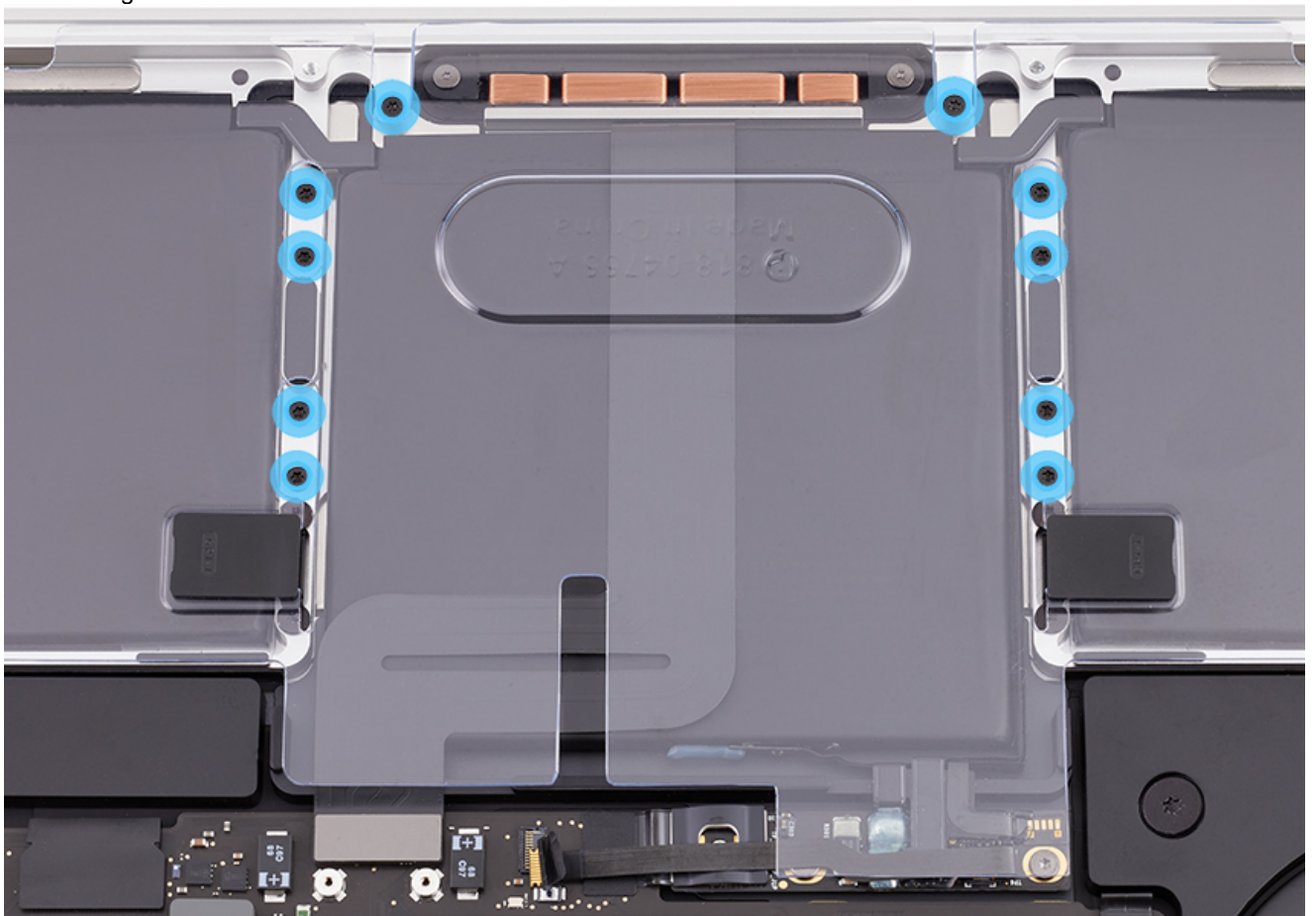




2. Remove two T3 screws from the trackpad flex cable cowling, then remove the cowling. Disconnect the trackpad flex cable from the logic board.



3. Remove eight T5 side screws and two T5 center screws.

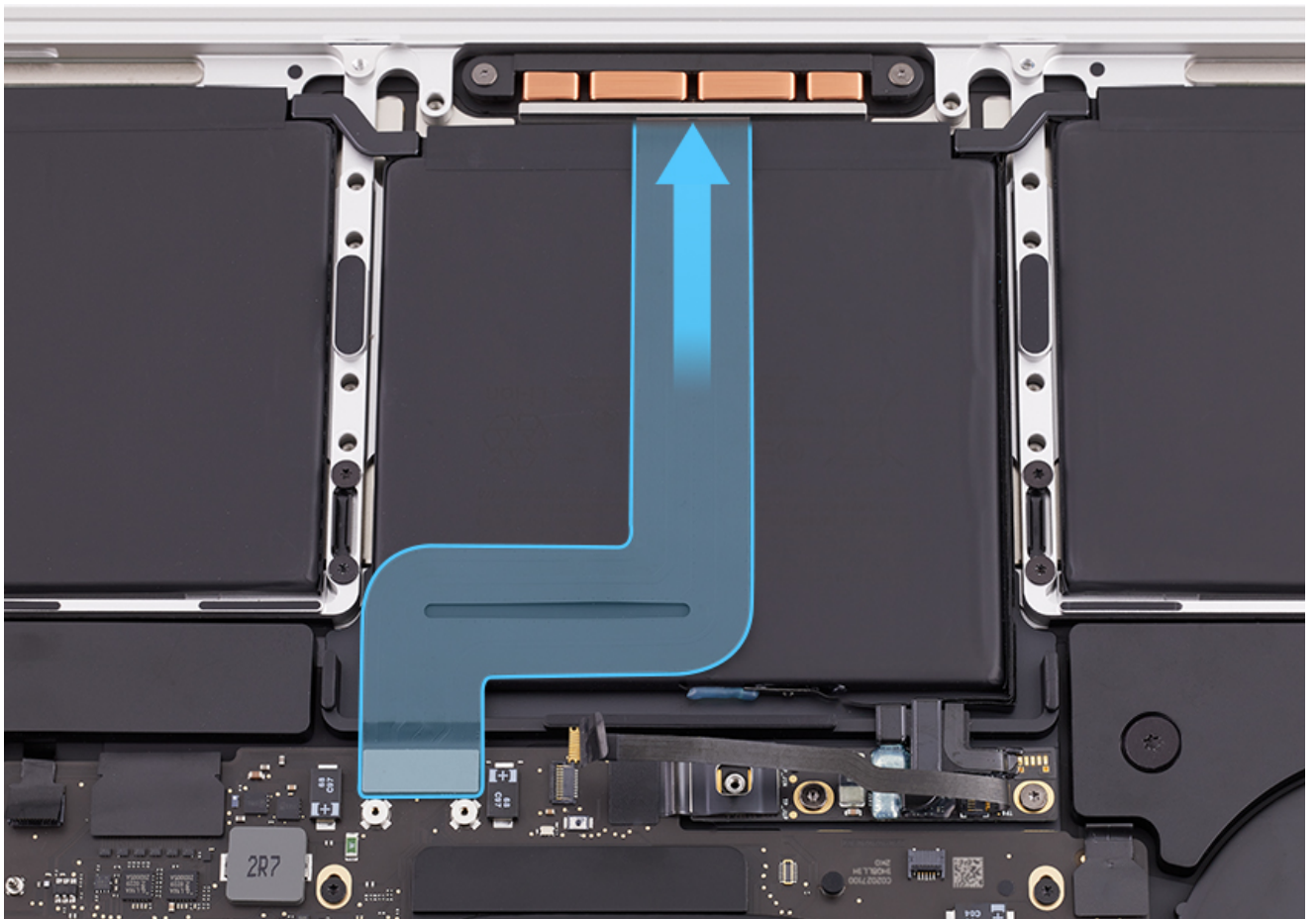


4. Temporarily remove the battery cover. The trackpad flex cable is adhered to the battery cells. Using your fingers only, carefully separate the keyboard flex cable from the battery cell.



**Warning:** Don't use a black stick or metal tool when the battery cover is removed. Use your fingers only.

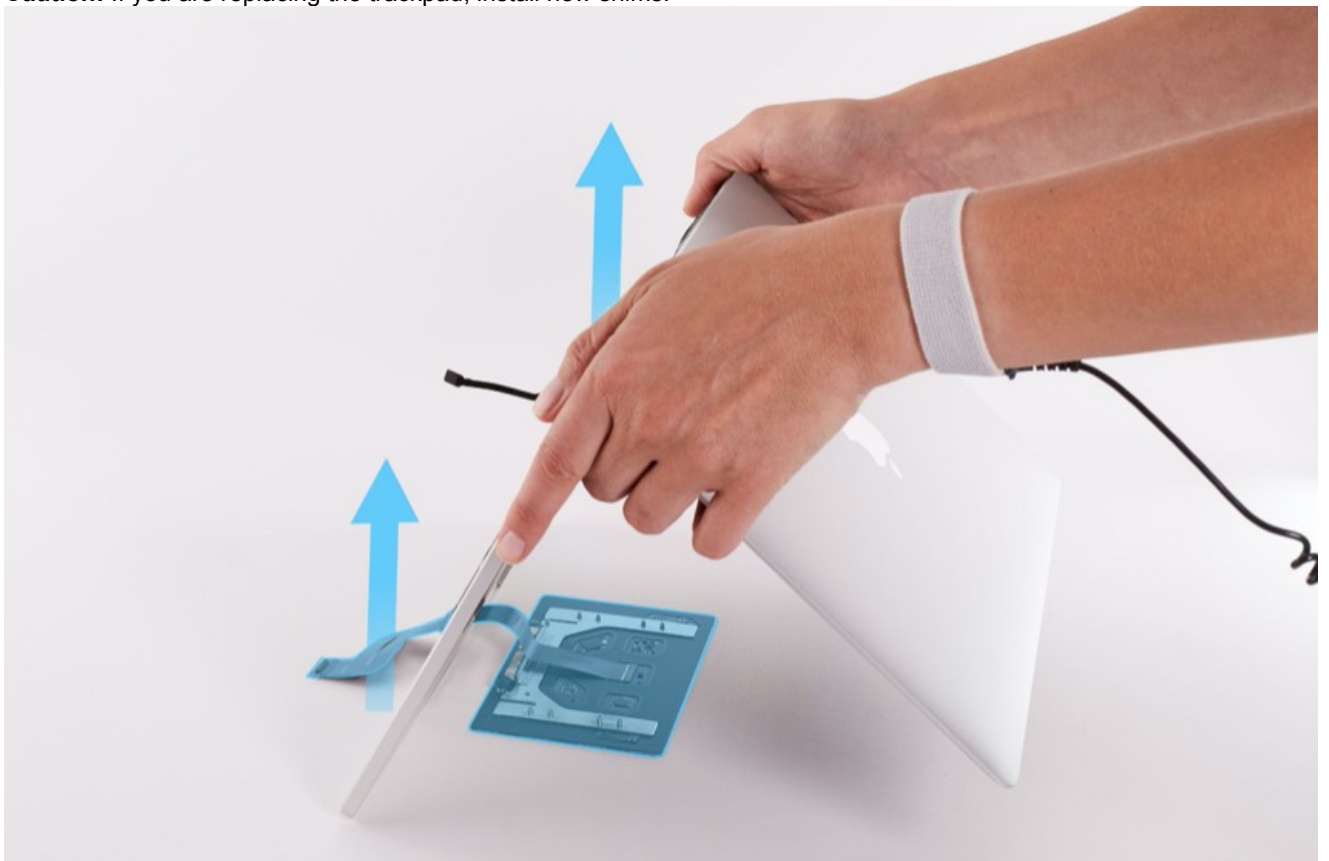




5. Lift the computer off the table while threading the trackpad cable through the top case opening. Leave the trackpad flat on the table to prevent the shims from falling off and getting lost.



**Caution:** If you are replacing the trackpad, install new shims.



6. Replace the battery cover and set the computer assembly aside.

## Steps For Reassembly



**Important:**

- If reinstalling the same trackpad, don't remove the trackpad flex cable unless it is damaged. If installing a new trackpad, replace the trackpad flex cable with a new one that is included with the replacement part.



- A replacement trackpad comes with three sizes of shims (0.100 mm, 0.150 mm, and 0.200 mm). Start with the 0.150 mm shim. Using ESD-safe tweezers, install new rectangle shims to the outer screw bosses and round shims to the middle screw bosses on the replacement trackpad.

Part Number	Size
806-05635	0.100 mm rectangle
806-05753	0.150 mm rectangle
806-05636	0.200 mm rectangle
806-05806	0.100 mm round
806-05808	0.150 mm round
806-05810	0.200 mm round



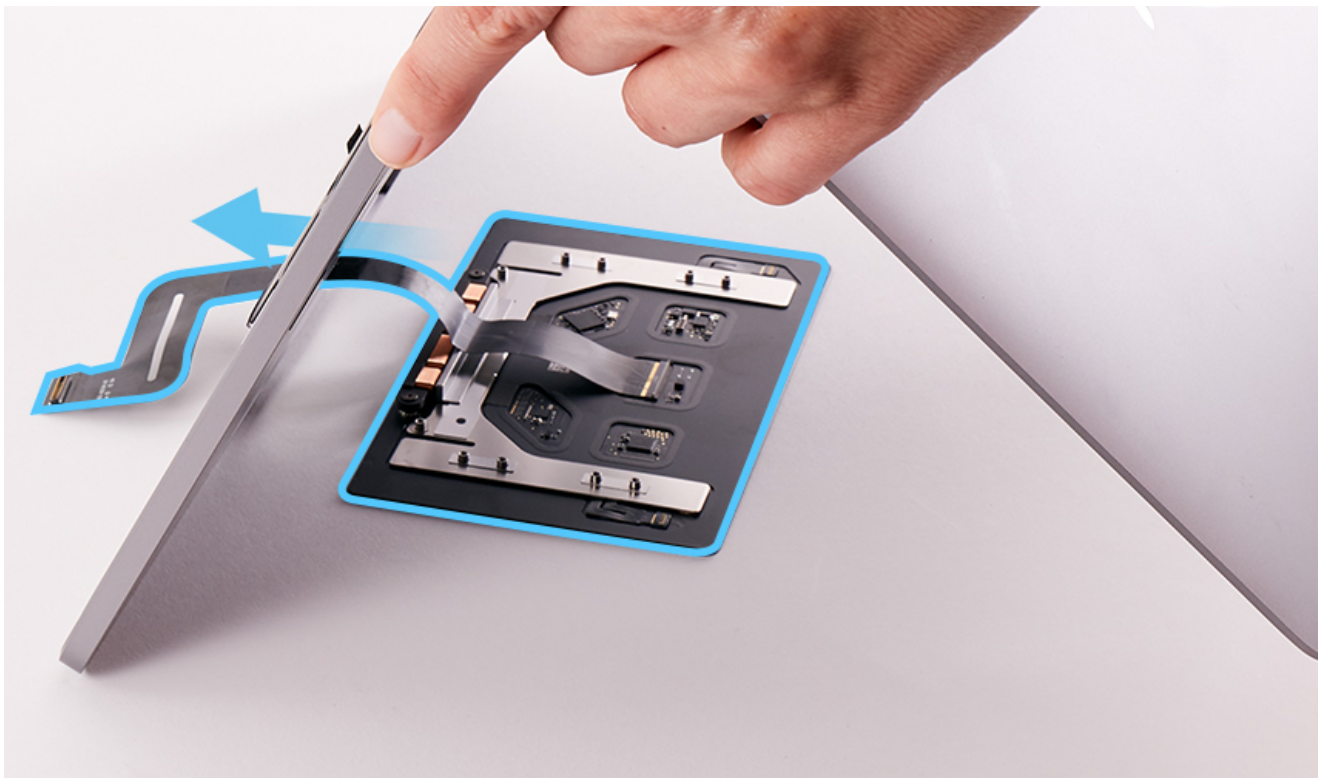
1. Temporarily remove the battery cover.



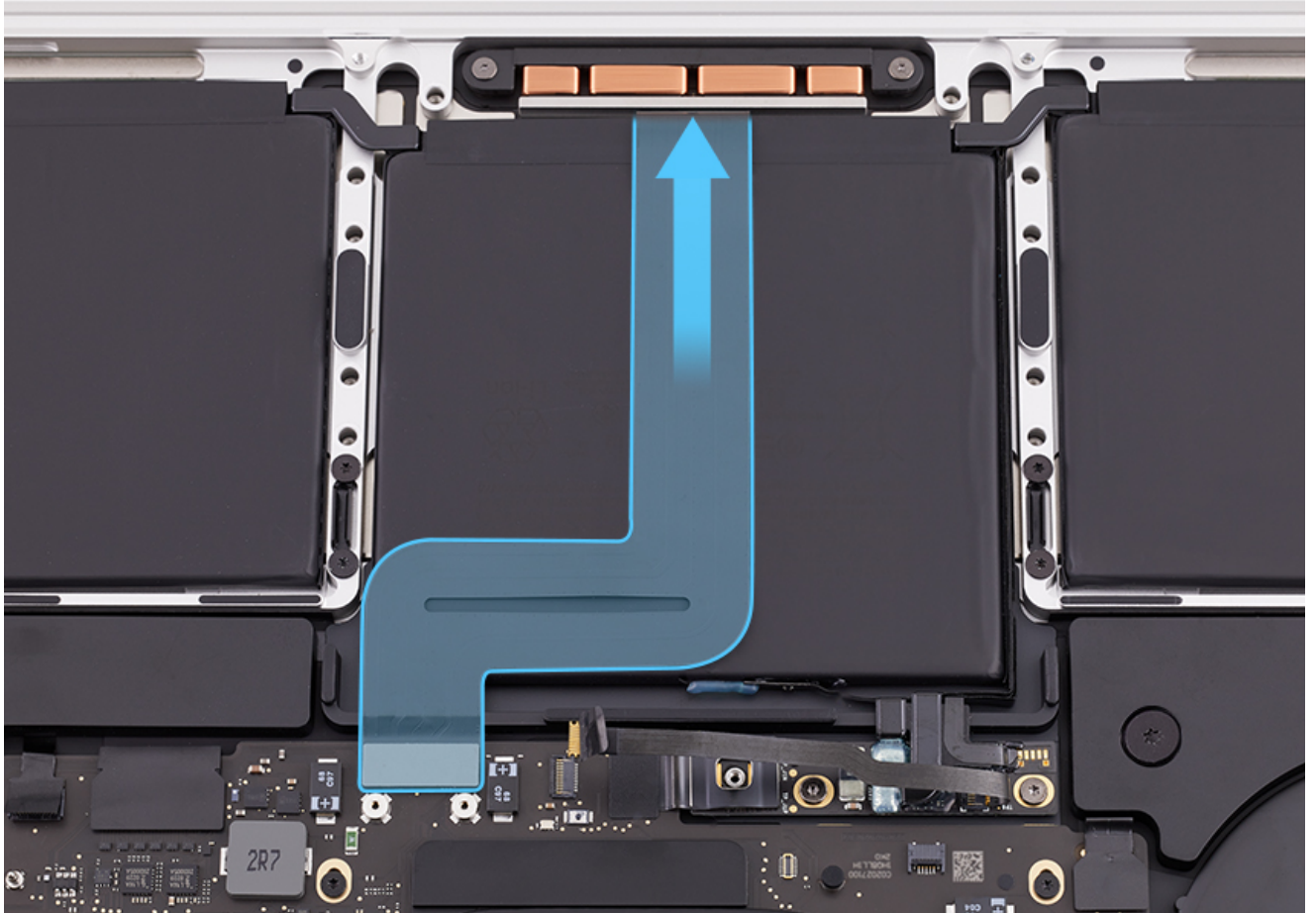
**Warning:** Don't use a black stick or metal tool when the battery cover is removed.

2. Place the trackpad flat on the table with the trackpad flex cable extended away from you. Thread the keyboard flex cable back through the opening in the top case. Slowly lower the computer with the display over the table edge and align the middle screw holes in the top case with the middle trackpad screw bosses.





3. Lay the trackpad flex cable flat, but don't yet adhere it to the battery cells.

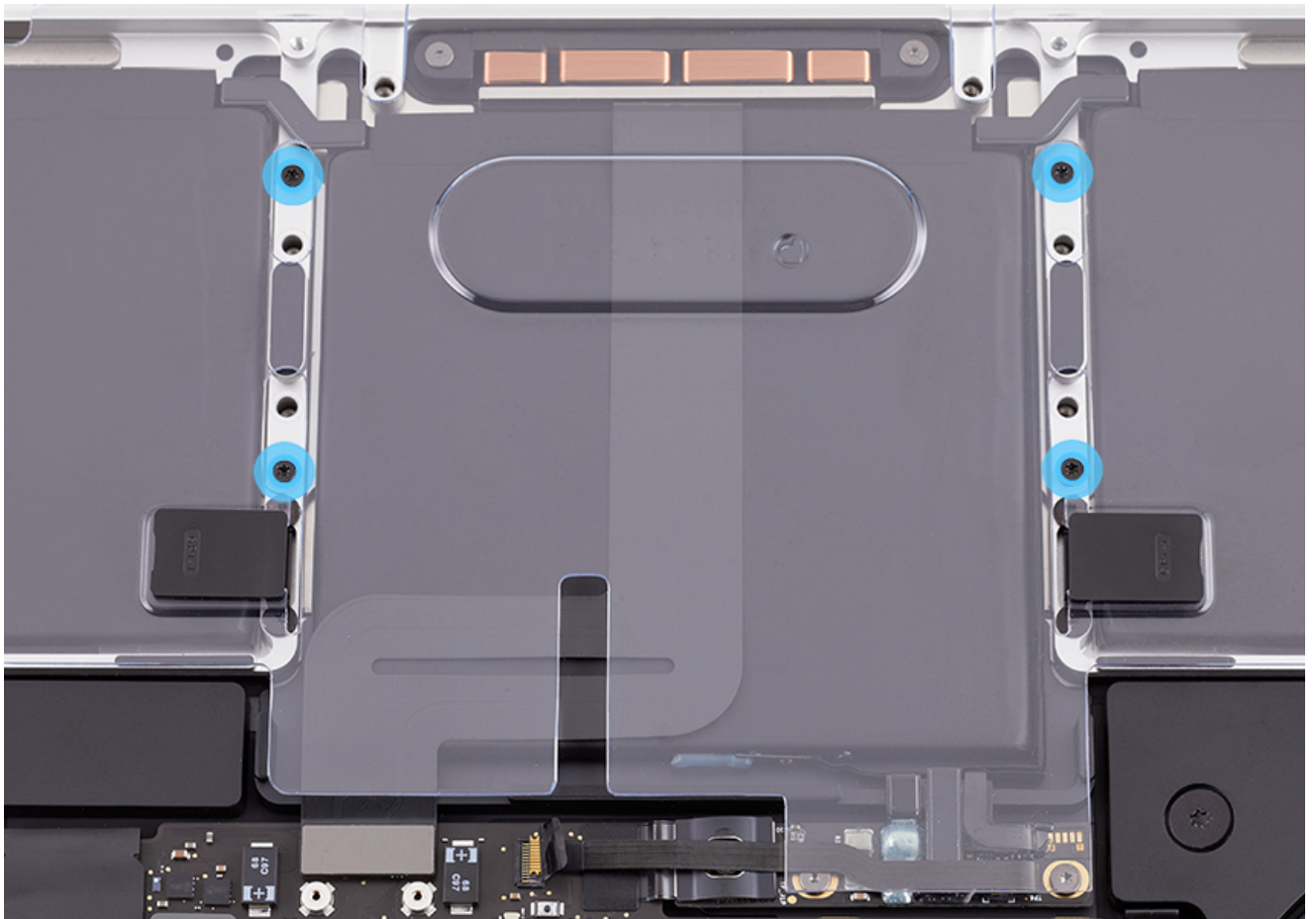


4. Reinstall the battery cover.



5. Partially install four T5 side screws (923-05257) in the outer screw holes to allow for trackpad alignment.





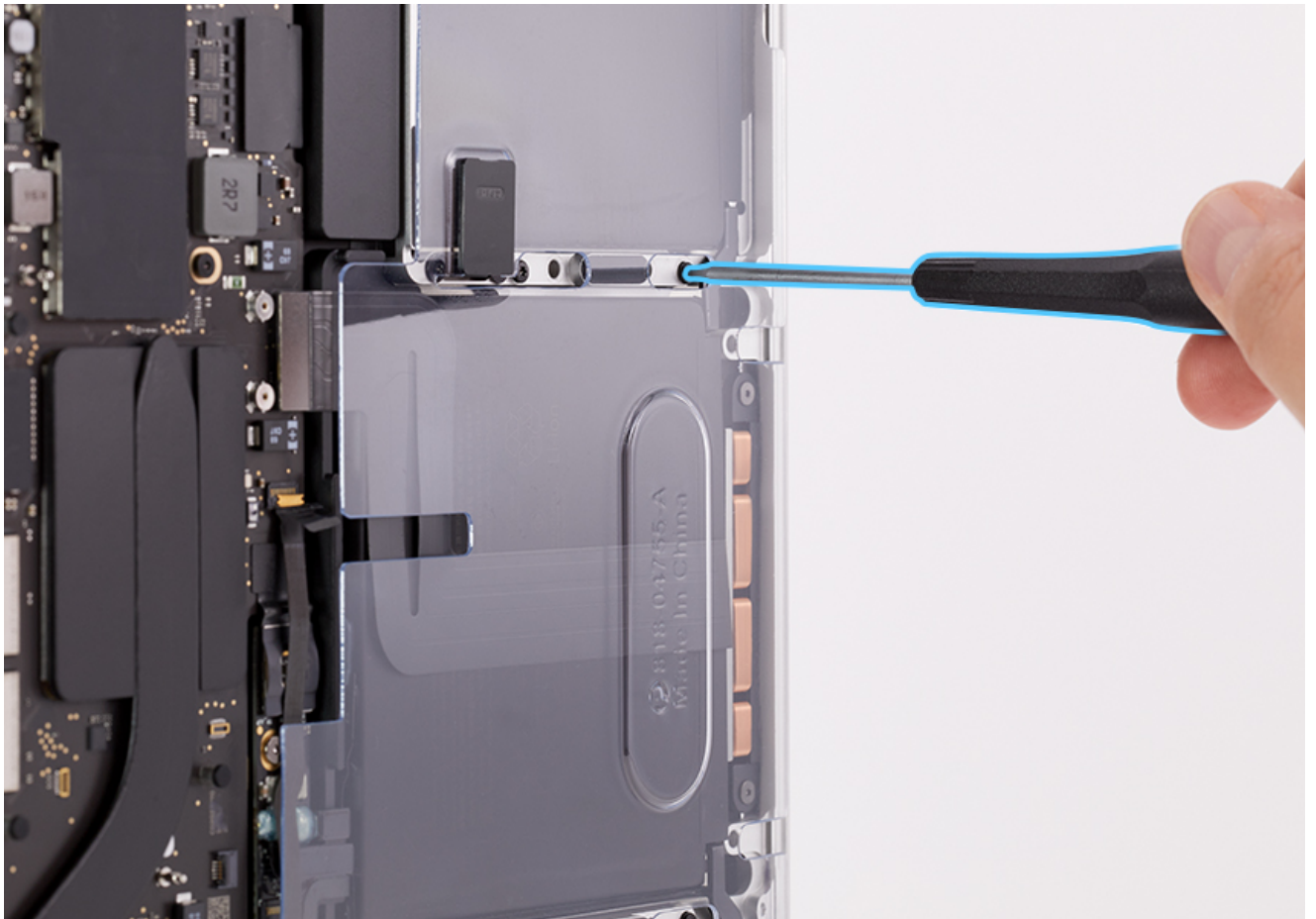
6. Turn the computer over and insert four gap offset tools in the corners of the trackpad. Place a piece of Kapton tape on each gap tool to keep the tools in place.

**Note:** A misaligned trackpad or improperly secured screws will likely result in failing the [Trackpad Calibration Check](#) (TP1314).



7. Place the open computer on its side. Use a T5 screwdriver to tighten the four outer screws.

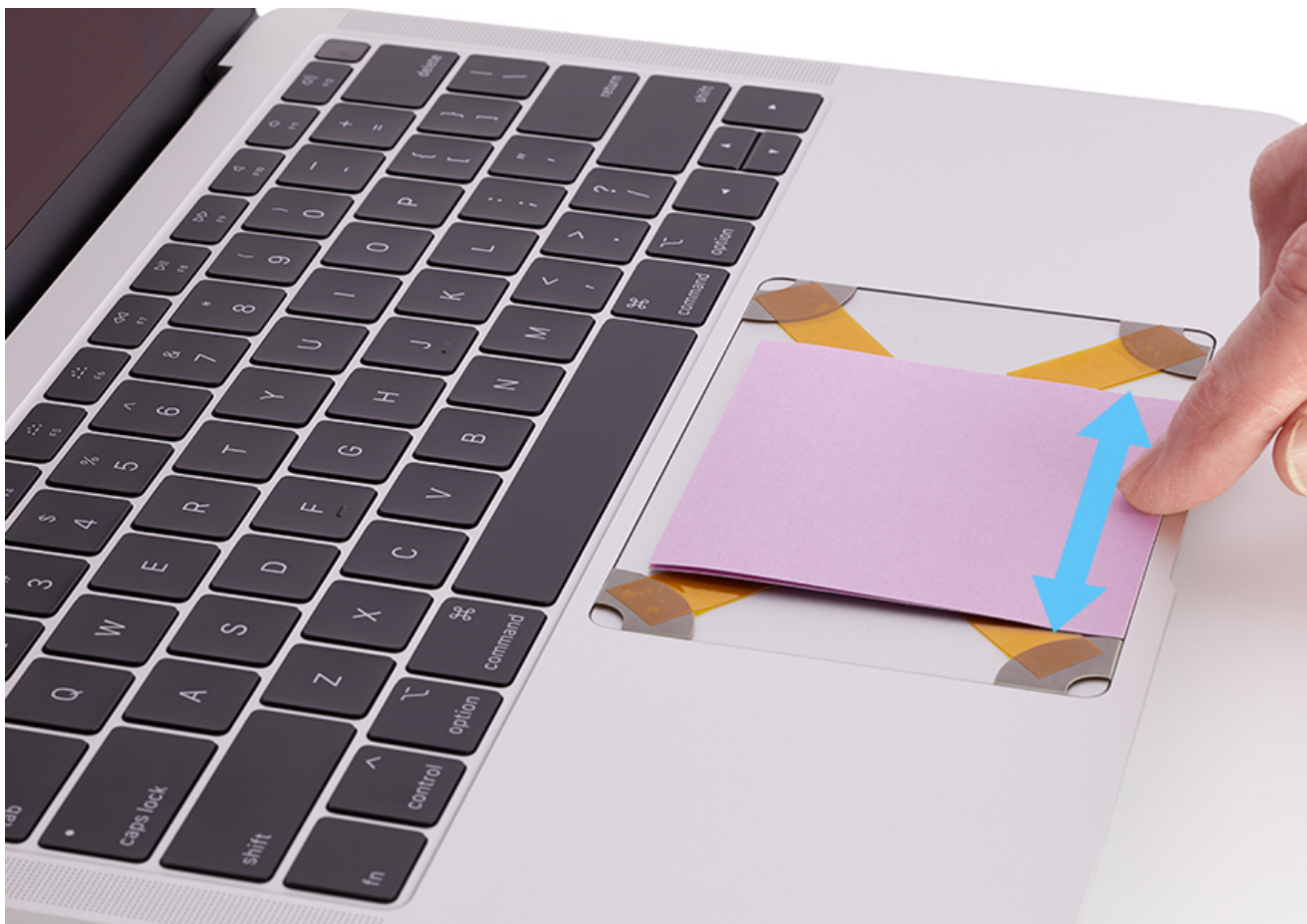




8. To test the trackpad is at the correct height, align a single sticky note on the upper edge of the trackpad. Run a finger over the top case and trackpad to verify the trackpad is flush with the sticky note.



9. Align a stack of two sticky notes to the bottom edge of the trackpad. Run a finger over the top case and trackpad to verify the trackpad is flush with the sticky note.



**Important:** If the trackpad is correctly aligned, continue with reassembly step #10. If the trackpad edges are higher or lower than the top case, follow removal steps #3–6 to remove the trackpad. Install the thinner 0.100 mm shims if the trackpad is higher than the top case. If the trackpad is lower than the top case, install the thicker 0.200 mm shims. Then, follow reassembly steps #1–9 to check alignment again.



10. Insert the T5 security bit into the adjustable 10–34 Ncm torque driver (923-02995). Set the torque value to 16 Ncm.





11. Reinstall the remaining four side T5 screws and two middle T5 screws. Then, tighten all 10 screws to 16 Ncm.

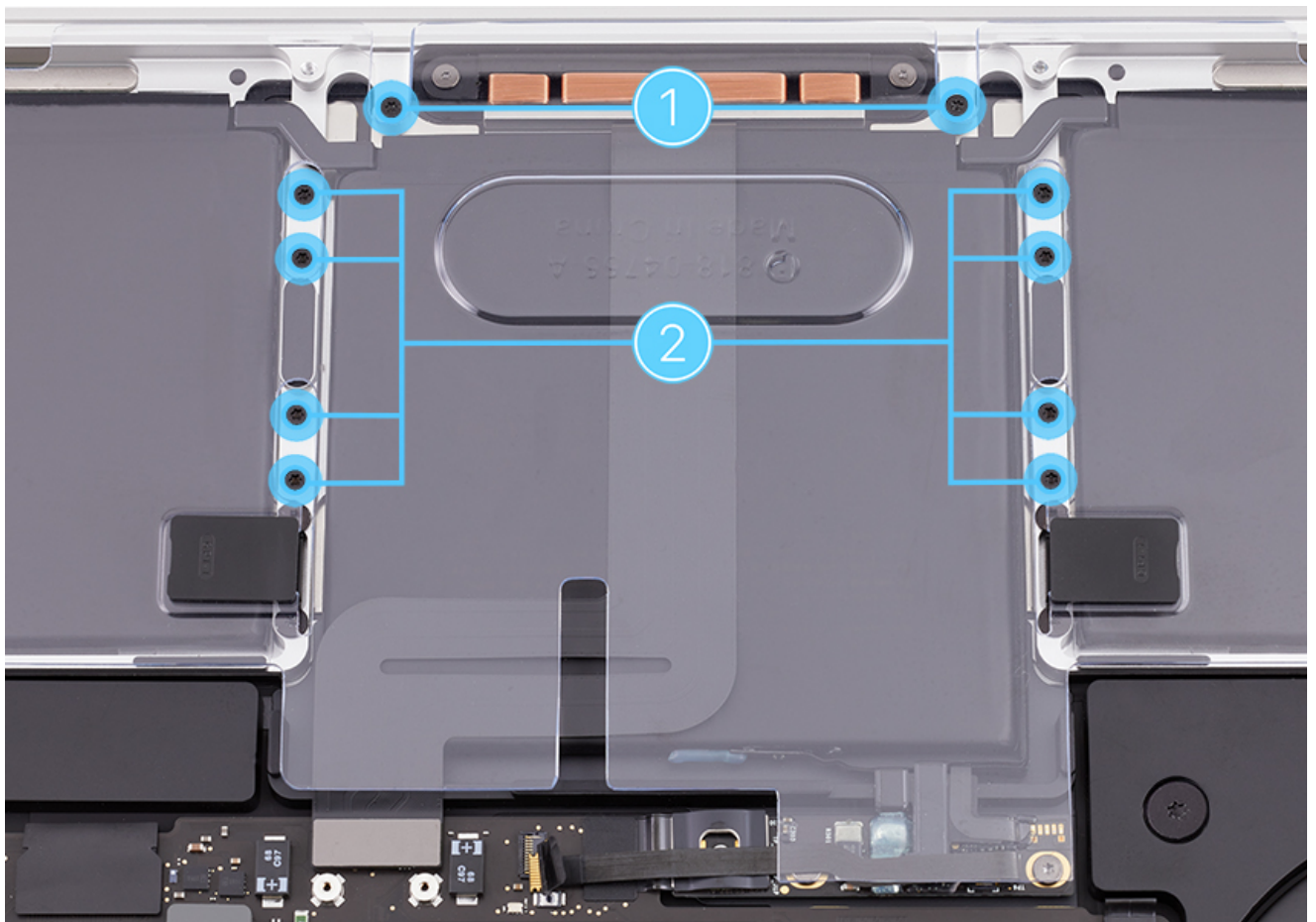
**Note:** A misaligned trackpad or improperly secured screws will likely result in failing the [Trackpad Calibration Check](#) (TP1314).

1. 923-05257 (side screws)



2. 923-05270 (middle screws)



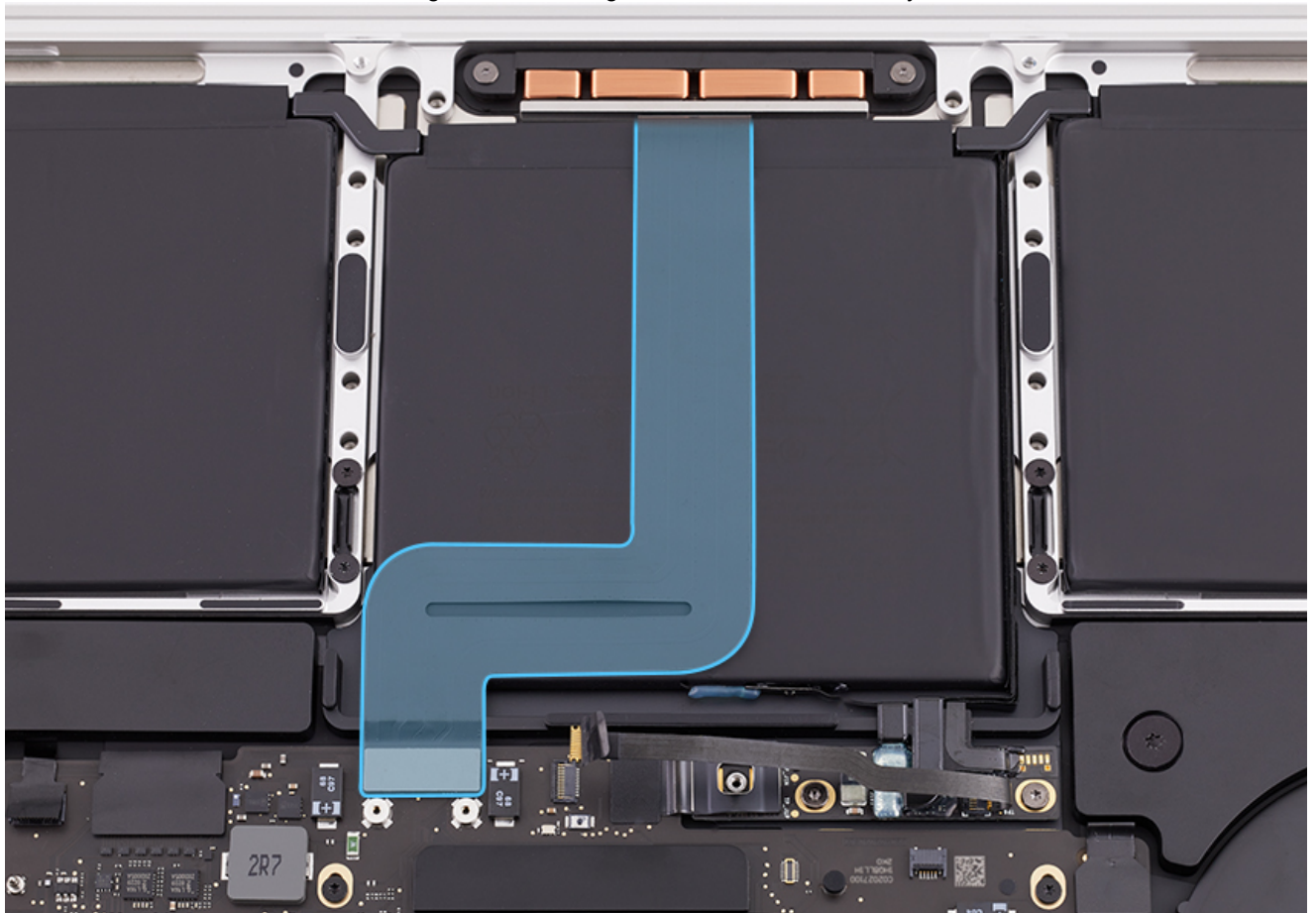


12. Temporarily remove the battery cover again.



**Warning:** Don't use a black stick or metal tool when the battery cover is removed.

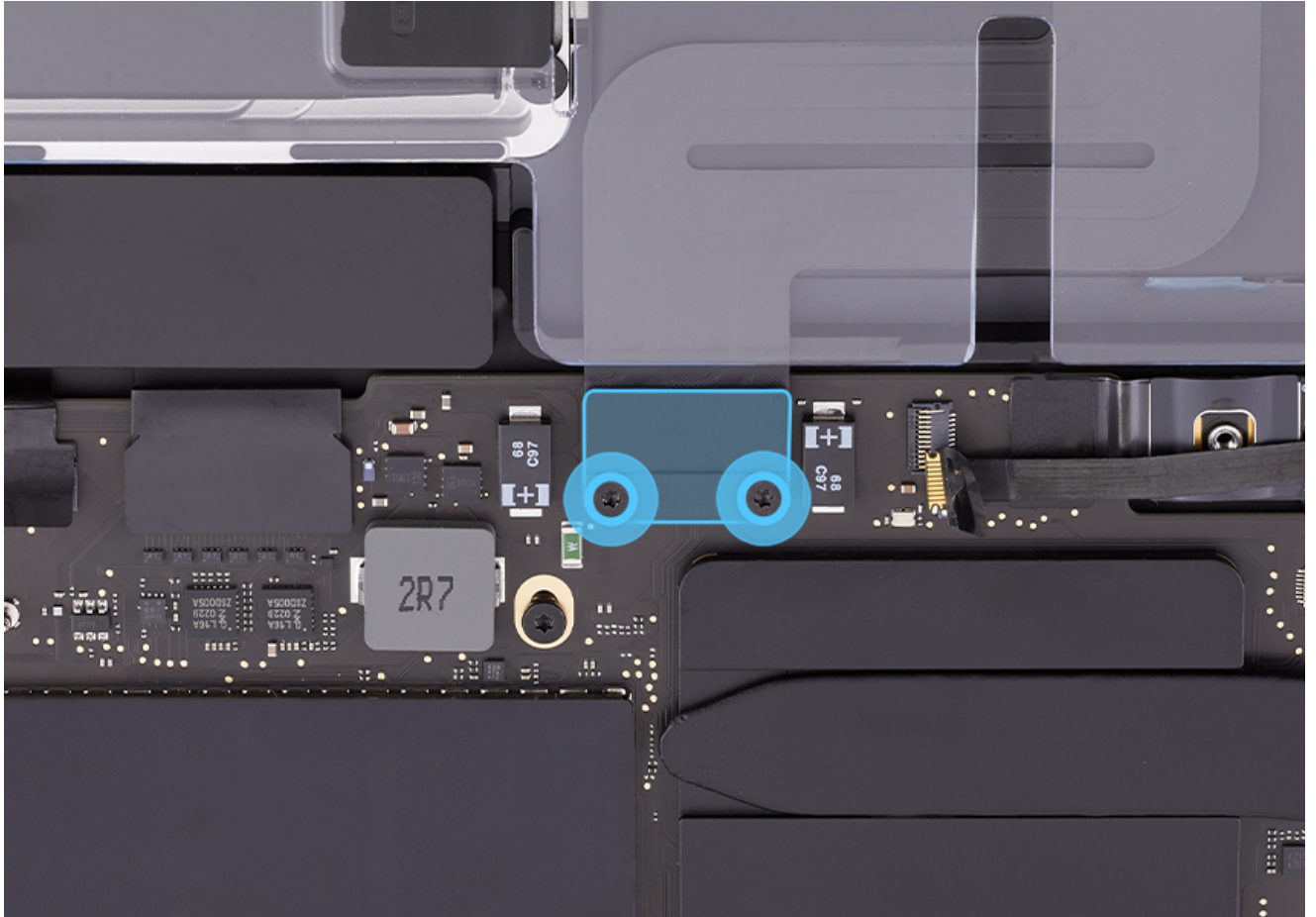
13. Gently run your finger along the trackpad flex cable to readhere it to the battery cells. If installing a new trackpad flex cable, first remove the adhesive backing before adhering the flex cable to the battery cells.



14. Reinstall the battery cover.

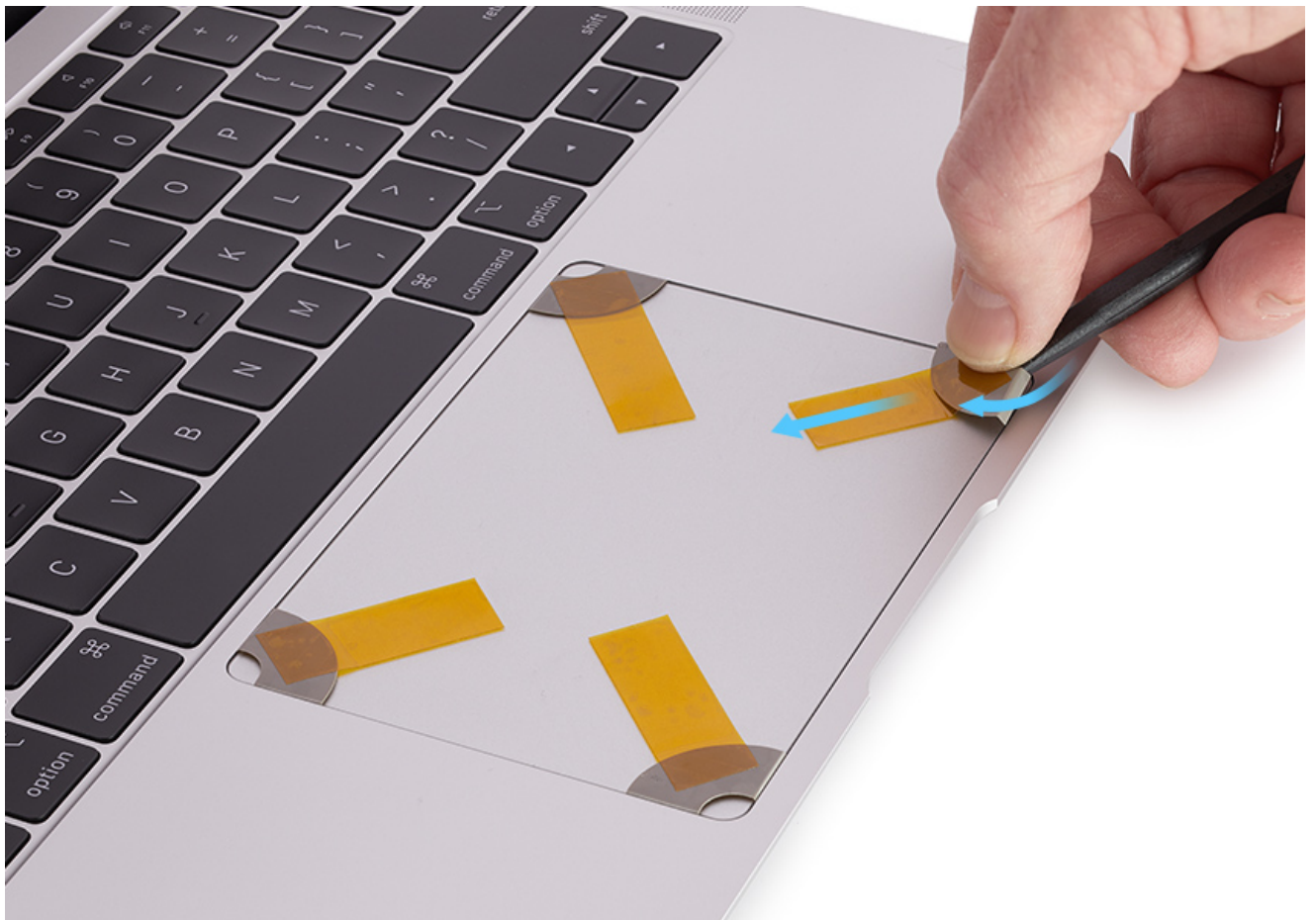


15. Reconnect the trackpad flex cable to the logic board. Reinstall the trackpad flex cable cowling and two T3 screws (923-5254).



16. Turn the computer over and use a black stick to lift off the gap offset tools and the Kapton tape.





17. [Reconnect the battery and remove the battery cover.](#)

18. Reinstall the [bottom case](#).

### Important

19. Run the appropriate [post-repair diagnostic suites](#) (TP1909).



# MacBook Pro (13-inch, M1, 2020) Top Case Assembly with Battery

## First Steps



### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- To avoid damaging parts, you must [attach the battery cover and disconnect the battery](#) (RP1693).
- Don't connect the computer to any external power source during repair.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Important:

- Regional top cases have the same base part number, but they include a language code prefix (for example, Italian = T661-18432). [Choose the correct keyboard language](#) (HT201794) when ordering a top case.

### System Configuration:

- **Important:** Completing the [System Configuration Suite](#) (TP1901) is required for the [logic board](#), [Touch ID board](#), [display](#), and [top case](#). Run the System Configuration suite to configure the top case with the computer.

### Remove:

- [Bottom Case](#)
- [Attach the Battery Cover and Disconnect the Battery](#)
- [BMU Flex Cable](#)
- [Clutch Covers](#)
- [Speakers](#)
- [Vent/Antenna Module](#)
- [Display](#)
- [Logic Board](#)
- [I/O Board](#)
- [Audio Board Flex Assembly](#)
- [Touch ID Board](#)
- [Fan](#)
- [Trackpad and Trackpad Flex Cable](#)



## Tools

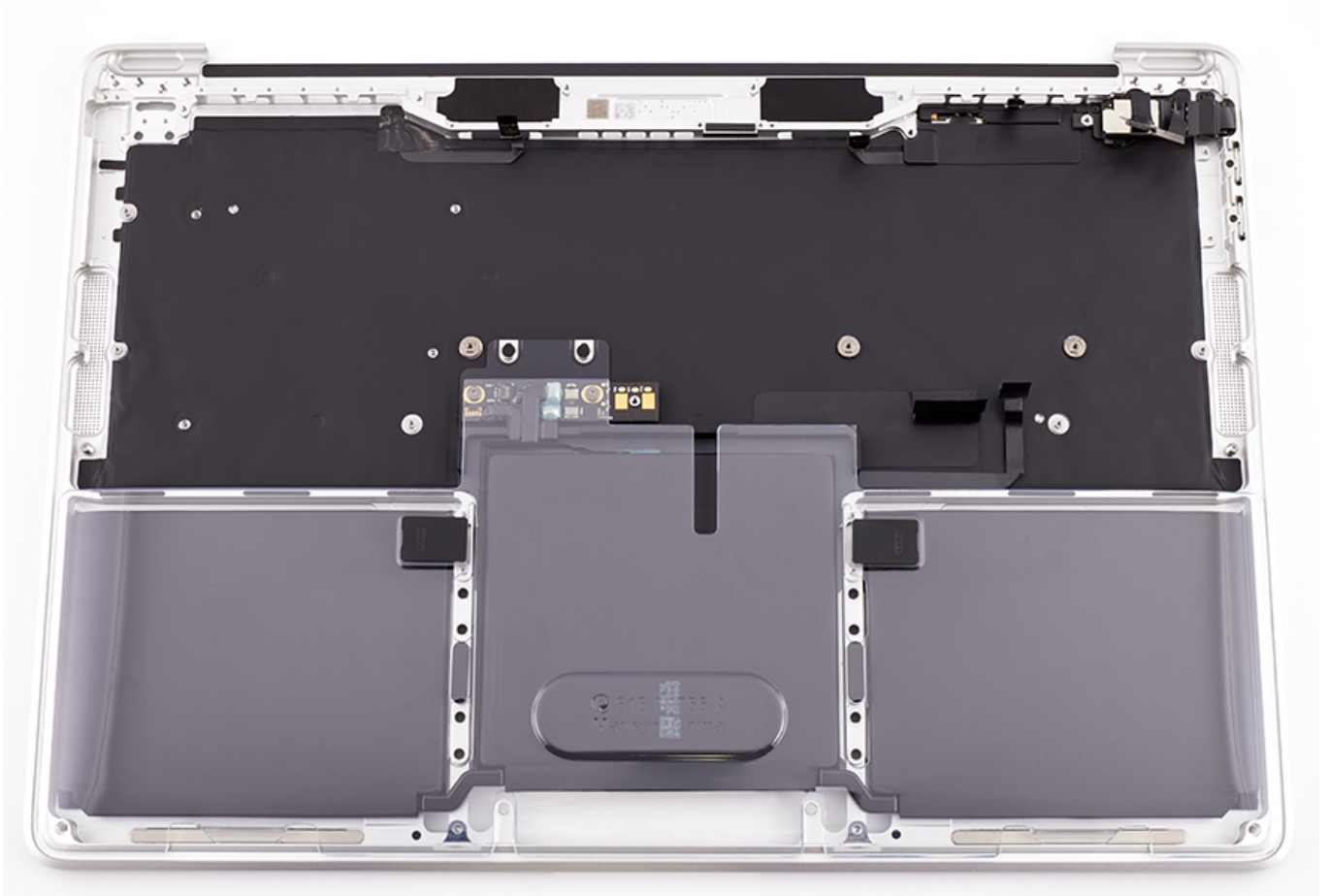
- No tools are required.

## Steps For Removal

After all the items listed above are removed, the top case is the only remaining part.

The top case includes the following:

- Battery and BMU board
- Keyboard and keyboard flex cable
- Microphone
- Touch Bar touch flex cable
- Touch Bar display flex cable



## Steps For Reassembly

1. Reinstall the [trackpad and trackpad flex cable](#).
2. Reinstall the [fan](#).
3. Reinstall the [Touch ID board](#) and apply new adhesive to the [Touch ID board flex cable](#).
4. Reinstall the [audio board flex assembly](#).
5. Reinstall the [I/O board](#).
6. Reinstall the [logic board](#).
7. Reinstall the [display](#).
8. Reinstall the [vent/antenna module](#).
9. Reinstall the [speakers](#).
10. Reinstall the [clutch covers](#).
11. Reinstall a new [BMU flex cable](#) that came with the top case.
12. [Reconnect the battery and remove the battery cover](#).
13. Reinstall the [bottom case](#).

## Important:

14. Run the [System Configuration suite](#) (TP1901) to configure the top case with the computer. Completing the System Configuration suite is required for [display](#), [logic board](#), [top case](#), and [Touch ID board](#) procedures.
15. Run the appropriate [post-repair diagnostic suites](#) (TP1909).

# System Configuration for Mac Computers with Apple Silicon



**Important:** If you replace the logic board in the user's computer, ensure the user has their data backed up. Data can't be recovered after the System Configuration suite is run.

## Contents of this article:

- [About System Configuration](#)
- [When System Configuration is Required](#)
- [Before Starting an Apple Service Toolkit 2 \(AST 2\) Session](#)
- [System Configuration Steps](#)
- [Troubleshooting Tips](#)

## About System Configuration

The AST 2 System Configuration suite is a required repair completion tool that configures a Mac after certain repair procedures. These repair procedures aren't complete until you successfully run the System Configuration suite. The System Configuration suite is not a diagnostic substitute and [post-repair diagnostic testing](#) (TP1909) must be completed after every repair.

System Configuration for Mac computers with Apple silicon has been simplified:

- A host computer is no longer required
- DFU mode is no longer required

**Important:** If you are attempting to complete the repair of an Intel-based Mac with the Apple T2 Security Chip, refer to [TP1657: System Configuration for Mac Computers with the Apple T2 Security Chip](#).

Successfully running the System Configuration suite:

- Ensures repair quality and compliance with regional communications regulations.
- Enables hardware encryption, biometric authentication, and secure startup protection.
- Optimizes performance and verifies proper configuration of hardware components.
- Conducts tests that verify that you correctly replaced parts and correctly reconnected parts during the repair, including the Touch ID sensor, ambient light sensor, Touch Bar, display, and camera.
- Pairs the Touch ID sensor and Touch Bar to the logic board and updates their calibration values for performance optimization.
- Writes the system serial number to the new logic board and reports it to Apple (if you replaced the logic board).  
**Note:** Reporting the logic board serial number to Apple enables iCloud services including FaceTime, Messages, and Apple Pay, and assigns the wireless region.
- You can see the completed steps in the AST 2 Diagnostic Console by selecting the suite in Diagnostics Results and clicking Details.

**Note:** For the purpose of this procedure the term Unit Under Test (UUT) will be used to describe the user's computer.

## When System Configuration is Required

### Perform System Configuration after these parts are replaced:

Model	Display	Logic Board	Top Case	Touch ID Board
MacBook Air (M1, 2020)	•	•		•
MacBook Pro (13-inch, M1, 2020)	•	•	•	•
Mac mini (M1, 2020)		•		

**Important:** If you replaced the logic board, run the System Configuration suite, then [use Apple Configurator 2](#) (TP1954) to install the latest version of macOS, macOS Recovery, and update the firmware.

## Before Starting an AST 2 Session

1. Add the parts you replaced to the repair system.
2. Enter the known-bad board (KBB) and known-good board (KGB) serial numbers into the repair system.

### Caution:

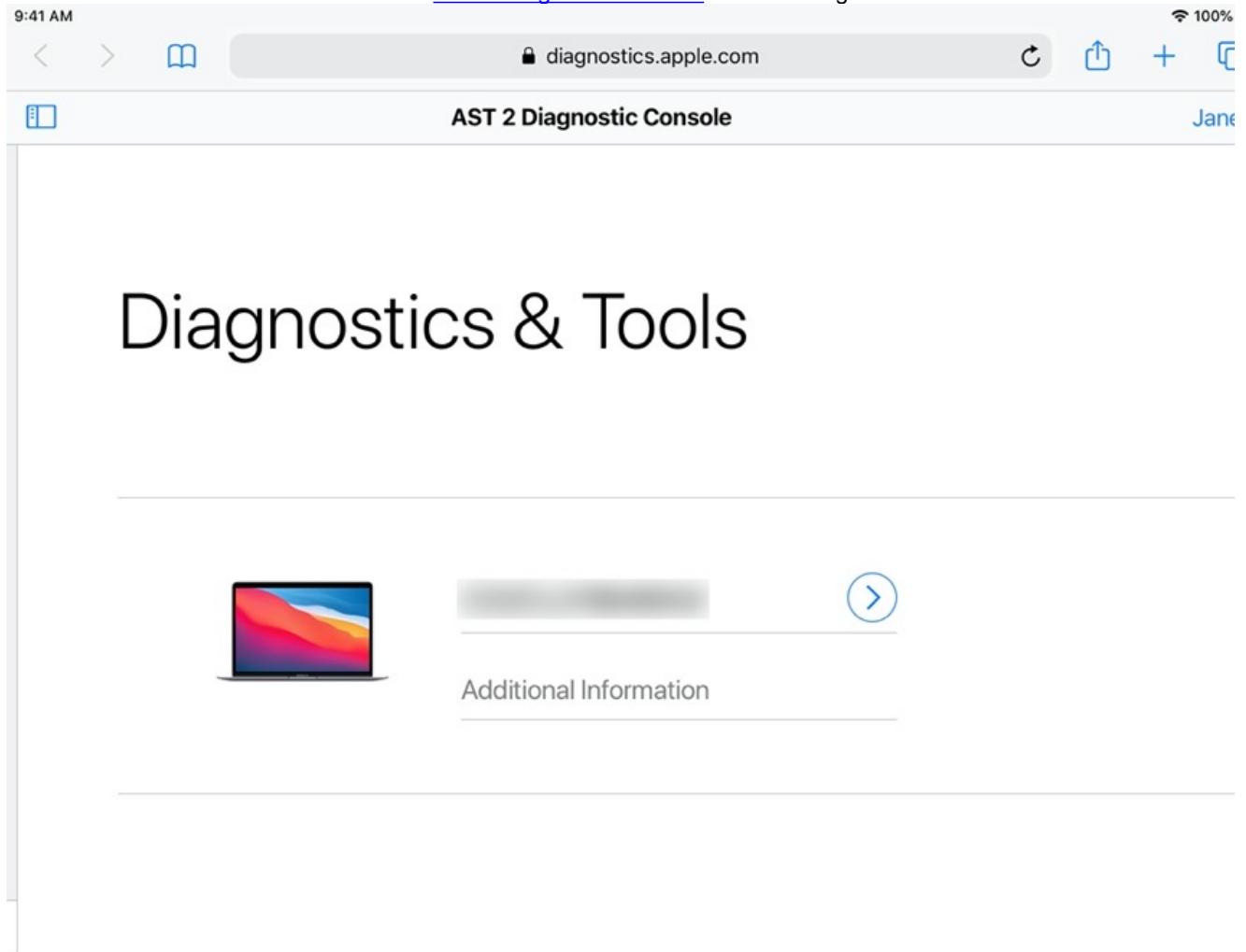
- You must use upper case characters for letters in the logic board serial number. To ensure accuracy, it is



- recommended to scan the 2D barcode.
  - If you enter wrong serial numbers or don't save the repair, the System Configuration suite won't become available.
3. Save the repair.

## System Configuration Steps

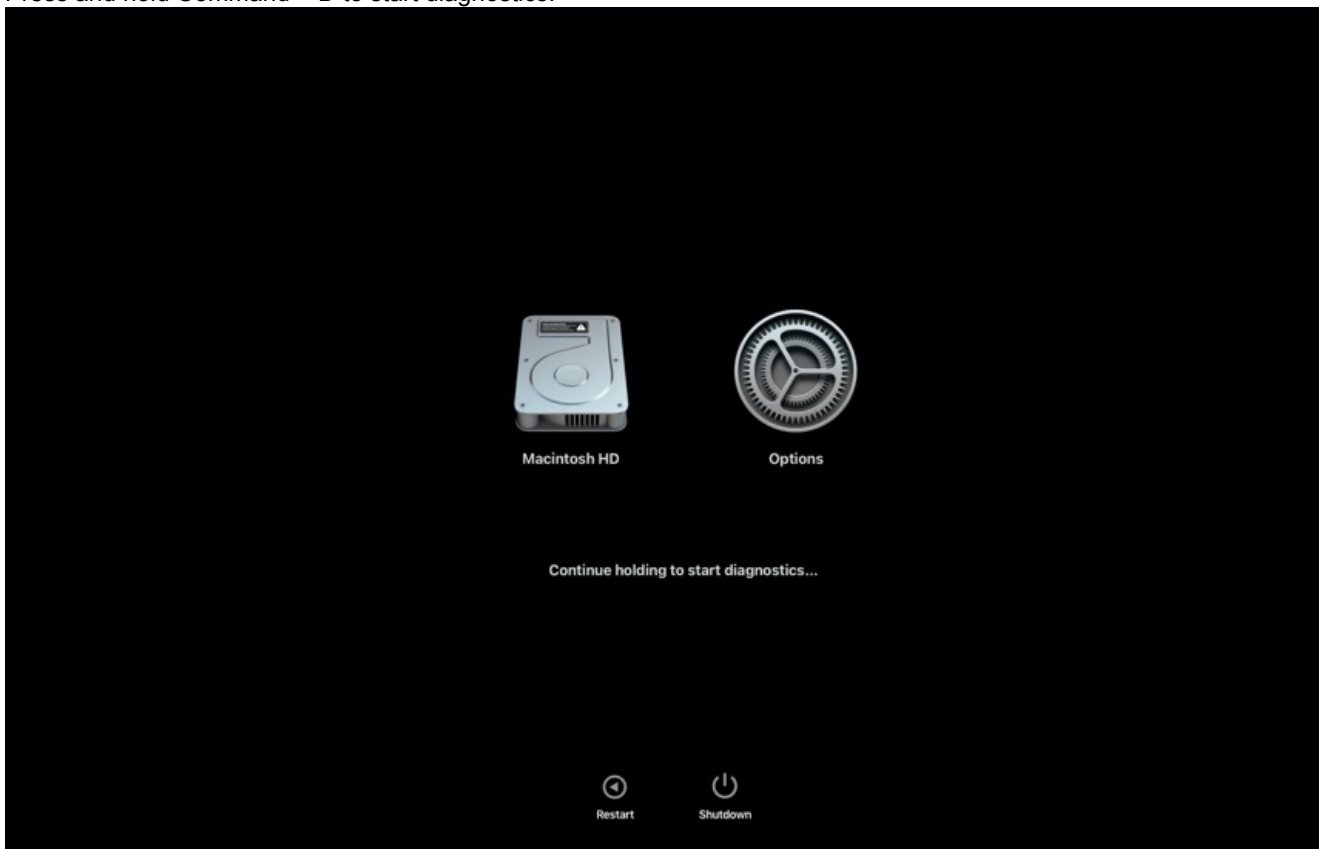
1. Enter the serial number of the UUT in the [AST 2 Diagnostic Console](#) to start a diagnostic session.



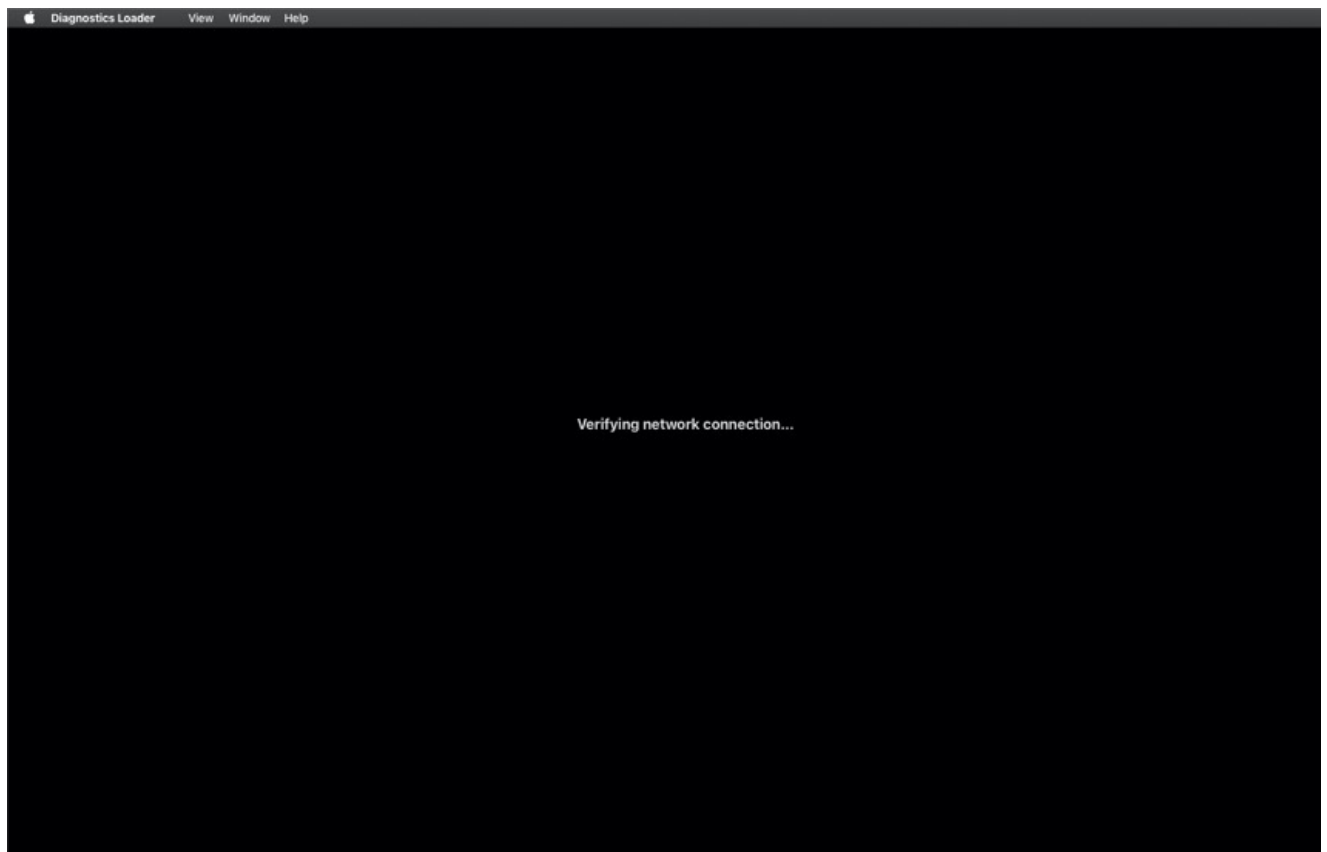
2. On the UUT, press and hold the power button for 10 seconds to start up to startup options.  
**Important:** After replacing a logic board, the UUT will automatically start up in Diagnostics Mode, during which you'll hear the UUT chime twice. Skip to step 4.



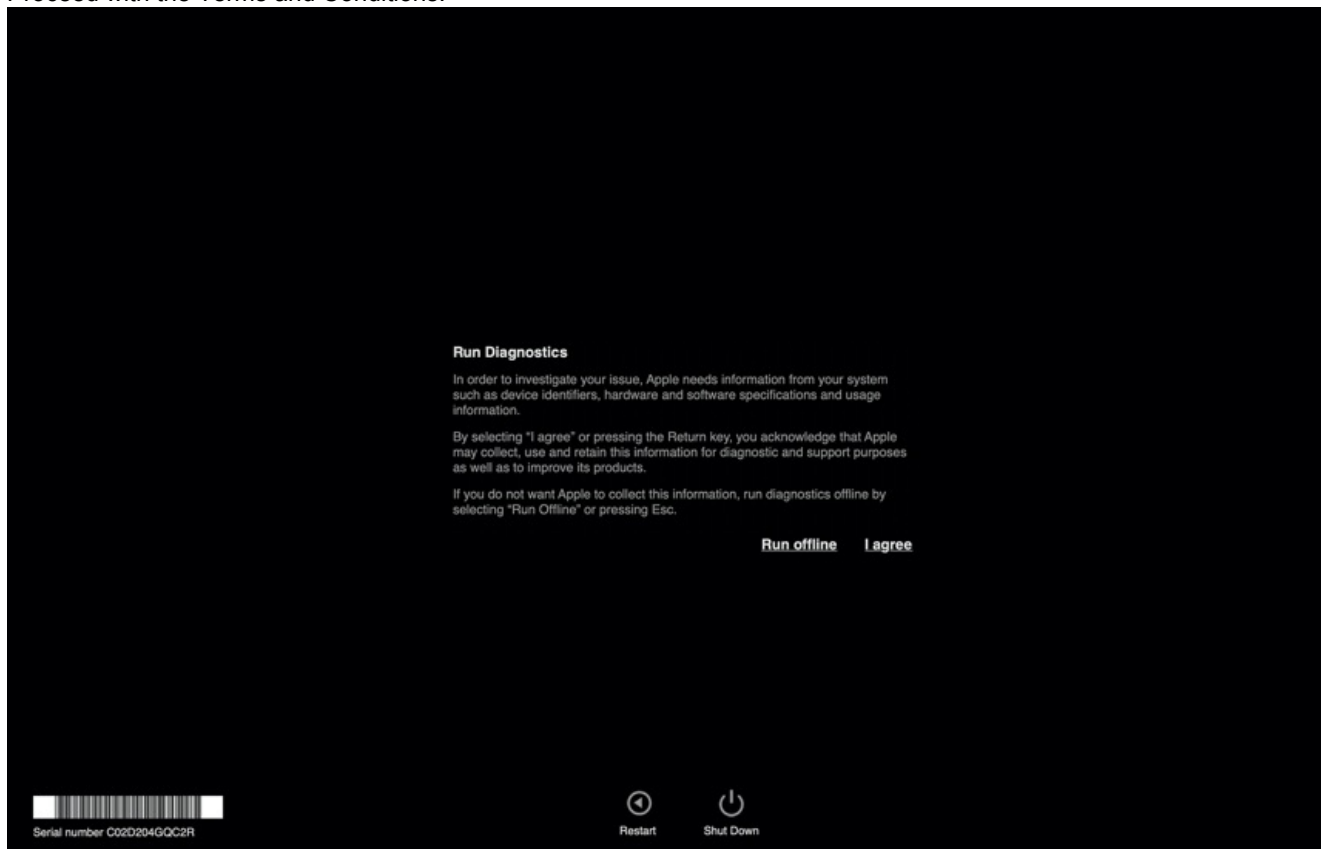
3. Press and hold Command + D to start diagnostics.



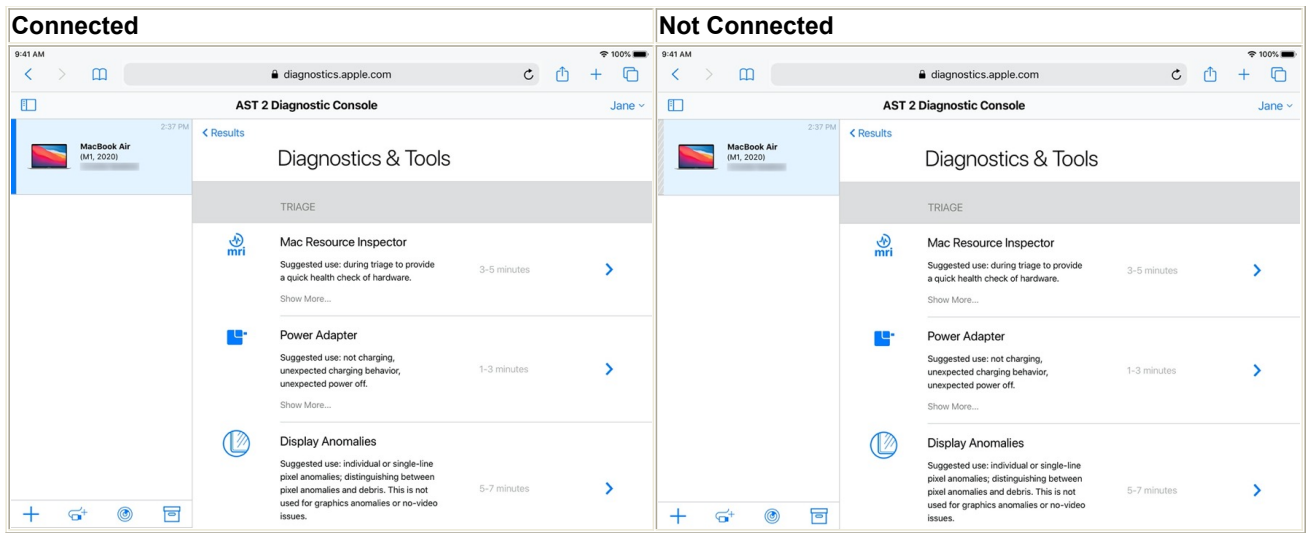
4. Connect to the network (Wi-Fi or Ethernet).



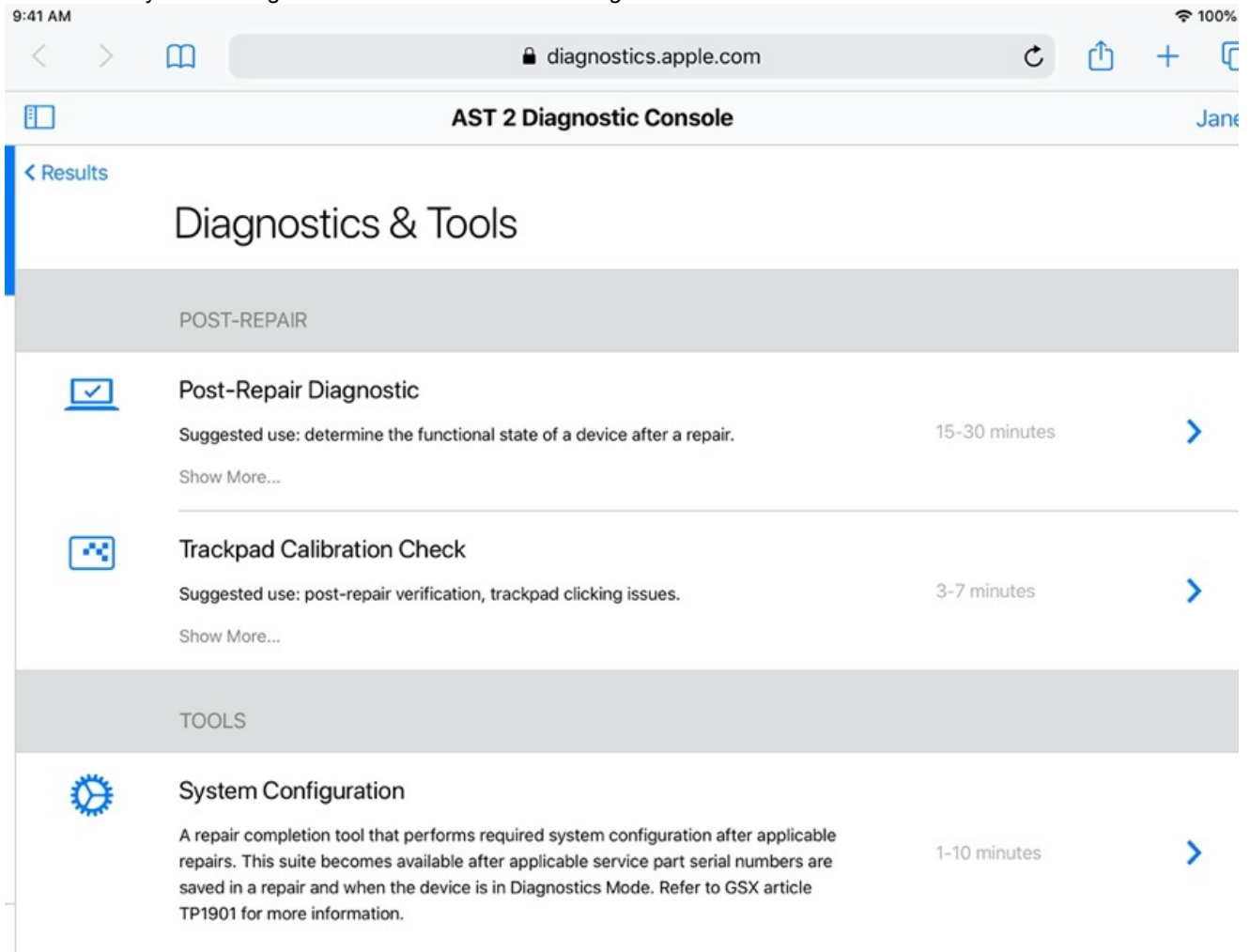
5. Proceed with the Terms and Conditions.



6. Confirm that a blue bar is next to the UUT in the AST 2 Diagnostic Console.  
**Important:** Refer to the Troubleshooting Tips section at the bottom of this article if the bar next to the UUT does not turn blue.

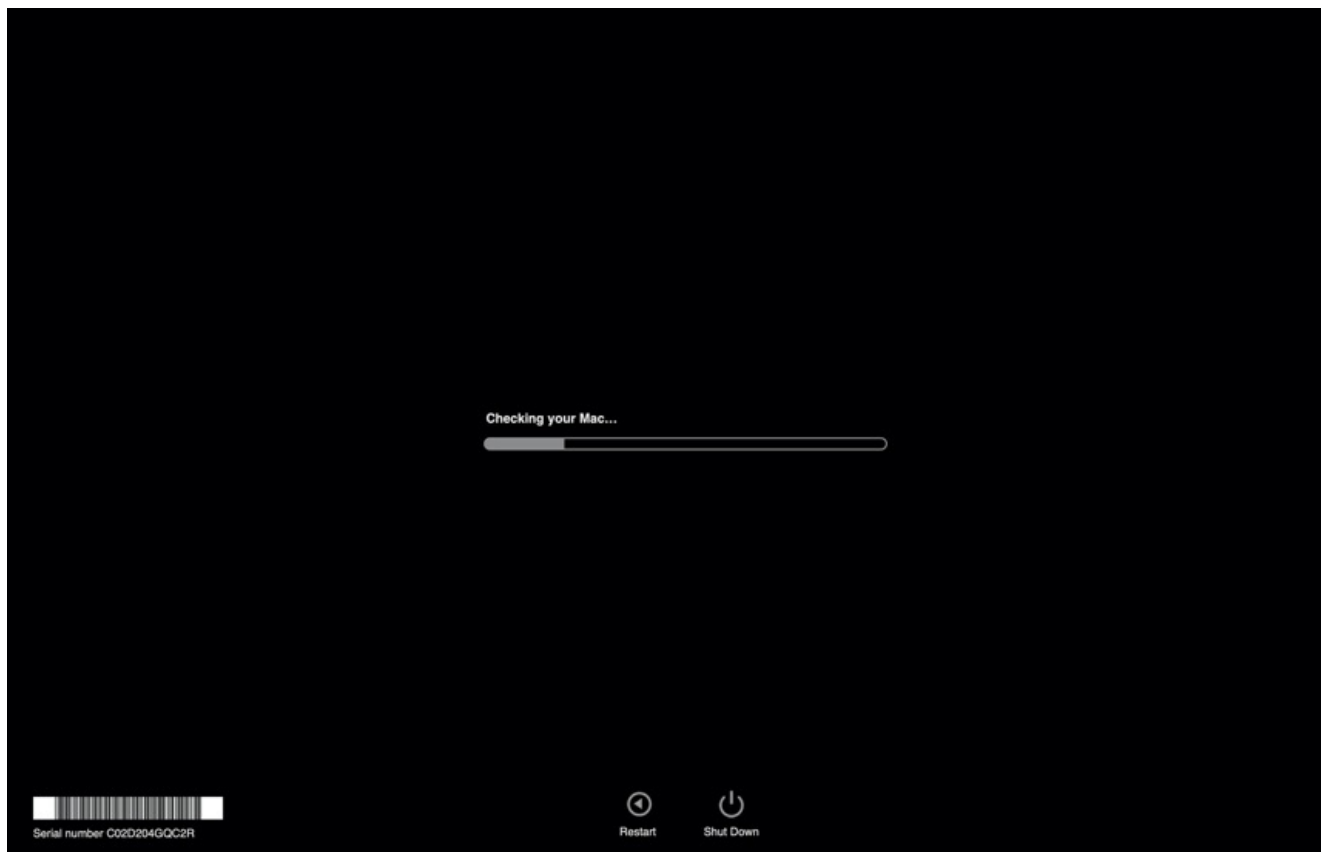


- Choose the System Configuration suite from the AST 2 Diagnostic Console.

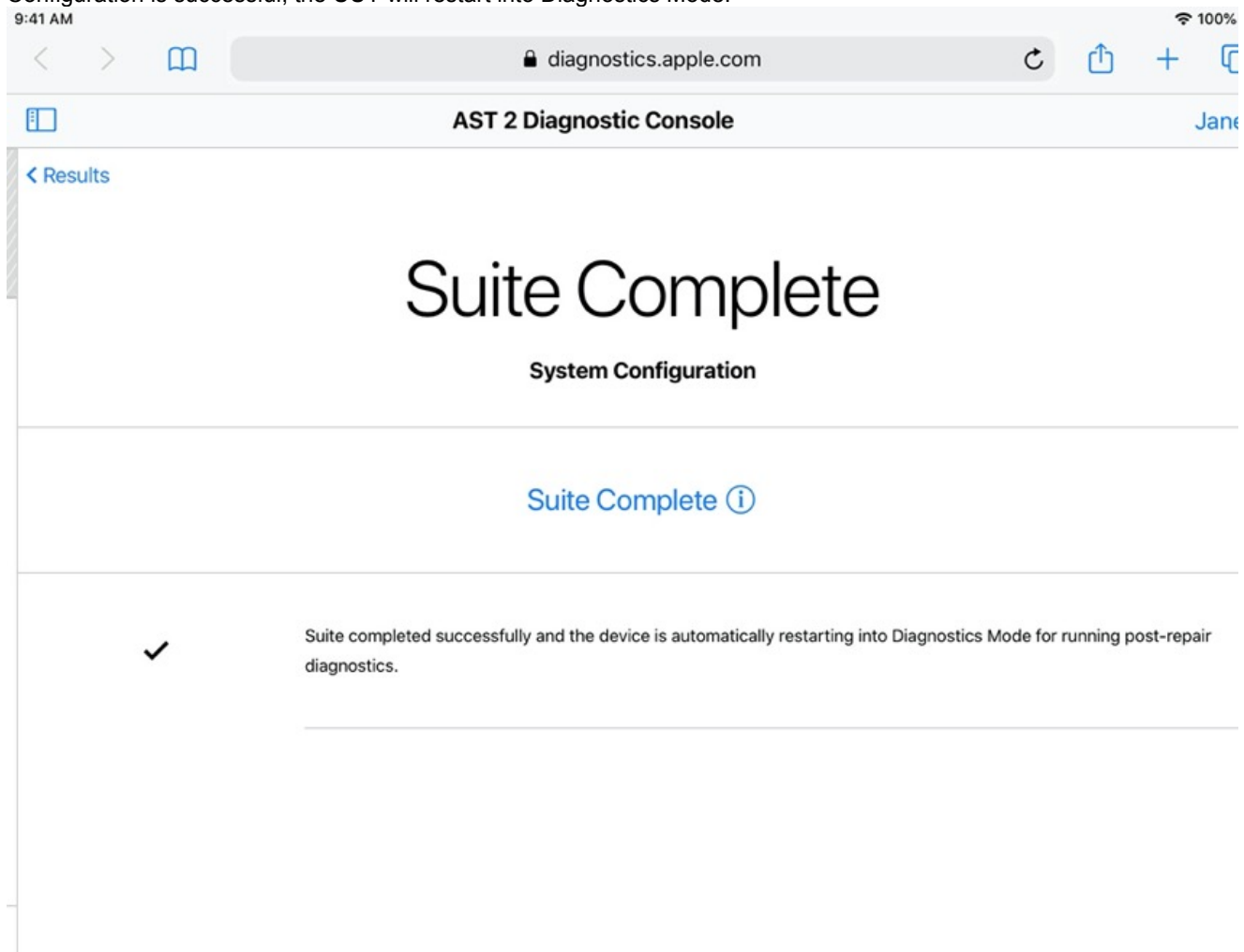


- The UUT will begin to run the System Configuration suite and will show a progress bar on the display.





9. Results will appear in the AST 2 Diagnostic Console once the System Configuration suite is complete. If System Configuration is successful, the UUT will restart into Diagnostics Mode.



10. If issues are found and the System Configuration suite fails, follow the instructions on the AST 2 Diagnostic Console and escalate to Channel Service Support (CSS).

**Important:**

- If you replaced the logic board, follow the restore steps in the [Apple Configurator 2 User Guide](#) to install the latest

version of macOS, macOS Recovery, and update the firmware. Additional details are available in [TP1954: When to use Apple Configurator 2 for Mac Computers with Apple Silicon](#).

- Run the necessary [post-repair diagnostic tests and suites](#) (TP1909) to ensure a successful repair.
- For notebooks, ensure you run [trackpad calibration check](#) (TP1314) anytime the computer is opened.

## Troubleshooting Tips

- If the UUT does not activate (the gray bar doesn't turn blue) in the AST 2 Diagnostic Console, verify the following information:
  - The UUT is connected to the internet over Wi-Fi or Ethernet.
  - The UUT system serial number is correctly entered in the AST 2 Diagnostics Console and matches the serial number used to create the repair.
  - You correctly added the parts to the repair, the KBB and KGB part serial numbers are correct, and the repair has been saved.
- If the System Configuration suite isn't available, perform the following steps in the order listed:
  1. Verify the troubleshooting steps above.
  2. Archive and restart the diagnostic session.
  3. Restart the UUT into Diagnostics Mode.
  4. Open the UUT and confirm that all parts are properly installed and all flex cables are securely connected.
  5. If it has been more than 14 days since a logic board, top case, or display KGB serial number was added to the repair, escalate to CSS.
- If the diagnostic session is interrupted (the blue bar turns gray), perform the following steps:
  - Archive and restart the diagnostic session.
  - Check the network connection.
  - Open the UUT and confirm that all parts are properly installed and all flex cables are securely connected.
- Change the language on the UUT
  - The diagnostic session language on the UUT is determined by the language set in the user's macOS. If you need to change the language, start up the computer to the user's macOS and select a different language.

# Trackpad Calibration Check

## Trackpad Calibration Check

To verify that the trackpad is responding as expected, the Trackpad Calibration Check suite in AST 2 should be run after every repair, including when only the bottom case has been removed and reinstalled.

**Note:** It is recommended to also run the Trackpad (OS) suite after a top case has been replaced, or if the user is having issues related to trackpad functionality.

### Required Tools:

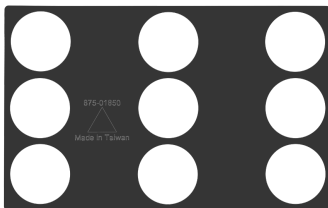
1. Weight Placement Rubber Template (model specific)
  - Refer to the Weight Placement Rubber Template section below to identify the correct template to use.
  - **Important:** If the Weight Placement Rubber Template edges start to curl, order a new pack. Templates come in a pack of three.
2. 200 g and 800 g weights (923-00462)



### Weight Placement Rubber Templates:

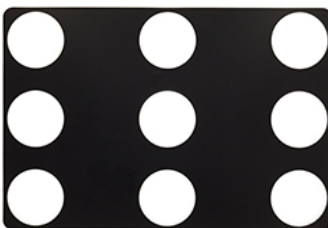
MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

- **923-00555**



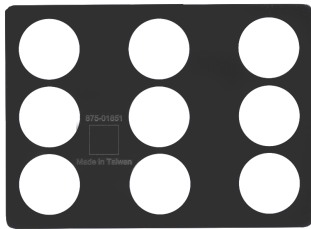
MacBook Air (Retina, 13-inch, 2018, 2019, and 2020) and MacBook Air (M1, 2020)

- **923-02462**



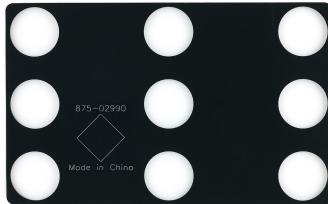
MacBook Pro (Retina, 13-inch, Early 2015) and (Retina, 15-inch, Mid 2015)

- **923-00599**



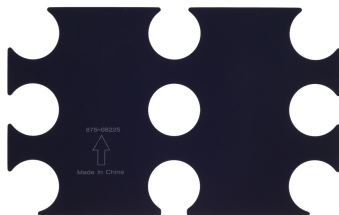
MacBook Pro (13-inch, 2016, 2017, 2018, 2019)

- **923-01316**



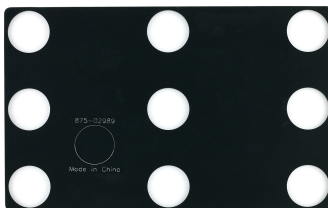
MacBook Pro (13-inch, 2020) and MacBook Pro (13-inch, M1, 2020)

- **923-04161**



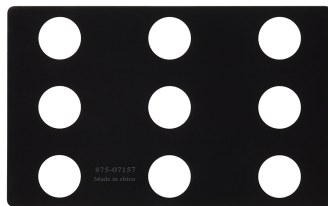
MacBook Pro (15-inch, 2016, 2017, 2018, 2019)

- **923-01317**



MacBook Pro (16-inch, 2019)

- **923-03890**



### Steps:

1. Place the appropriate Weight Placement Rubber Template on the trackpad before launching the Trackpad Calibration Check suite in AST 2. This establishes the correct baseline for the weights.
- Important:** Do not tape the Weight Placement Rubber Template to the top case. Tape may cause inaccurate test results.





2. Launch AST 2. In Diagnostic Console, select Trackpad Calibration Check from the list of diagnostic suites.

**Caution:** The Trackpad Calibration Check suite is very sensitive to external disturbances. Ensure the computer is on a flat surface before you begin. Don't run the Trackpad Calibration Check suite if the computer is on a bench where other technicians are working. To avoid interfering with the results, be sure to place weights down gently on a separate surface while running the suite. If the computer is bumped or jostled while the suite is running, restart the test.

[< Diagnostic Results](#)

# Diagnostic Suites

## TRIAGE



### Trackpad Response

Assists in verifying functionality of trackpad.



3 minutes



## REPAIR



### Trackpad Calibration Check

Verifies calibration of the trackpad actuator and force sensor.

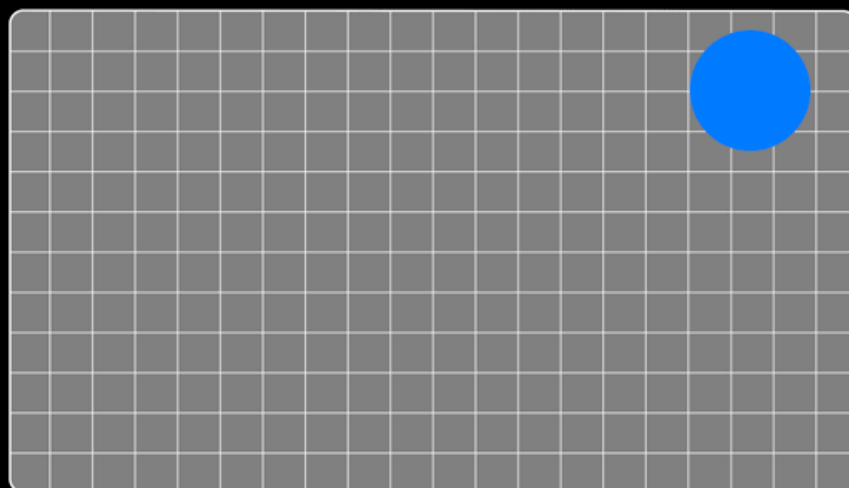


3 minutes



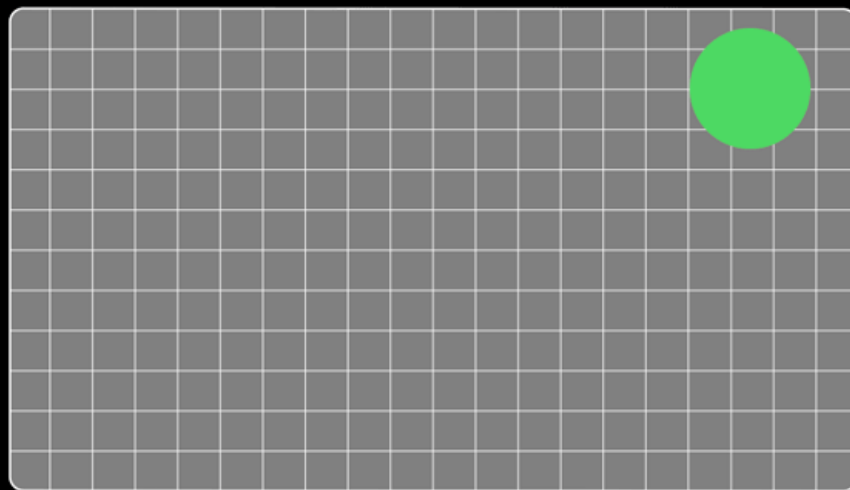
3. The Trackpad Calibration Check suite consists of several stages. The first stage of the suite is the Force Check, which is interactive and requires placing the 200 g and 800 g weights as indicated. The blue dot will indicate where on the trackpad to place each weight. The text at the bottom of the screen will indicate which weight to use at each step. The dot will turn green when it is time to lift the weight from the trackpad.

**Important:** Press an alphanumeric key to advance the test.



#### Test Instruction

Place the 200g weight on the indicated area and press any key.

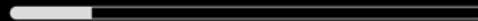


### Test Instruction

Remove the weight from the indicated area and press any key.

4. The next stage of the Trackpad Calibration Check suite is the Actuator Check. During this stage, the trackpad will make clicking sounds while the actuator is tested. If any issues with the actuator are identified, the suite may need to proceed to the next stage, which is the Actuator Calibration. The trackpad will continue to make clicking sounds while the actuator is calibrated. During this process, the unit under test (UUT) will display the screen shown below.

Checking your Mac...



5. If no issues are found, the screen will look like the image below. The trackpad calibration is verified.



About Device



Input Device

- ✓ Actuator Calibration
- ✓ Critical Error Test
- ✓ Open Test
- ✓ Force Check

6. If issues were found in the Force Check, Actuator Check, or the Actuator Calibration, the screen will look like the image below and the Trackpad Calibration Check suite should be run again. If the computer fails a second time, a top case replacement is recommended.



MacBook Pro  
C000094.02-01.00

# Issues Found

Trackpad Calibration Check  
October 20th, 2016 2:19 PM



About Device



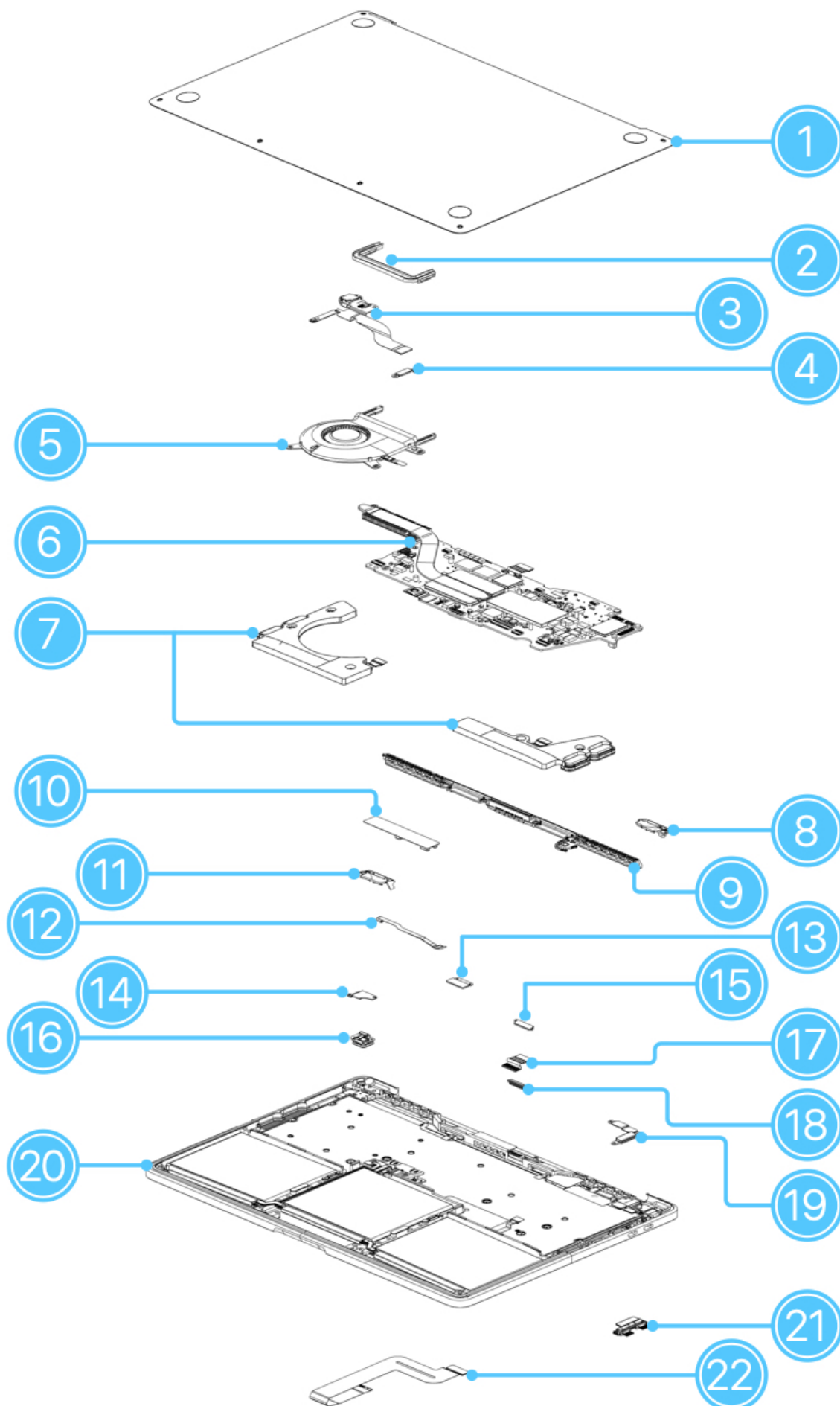
Input Device

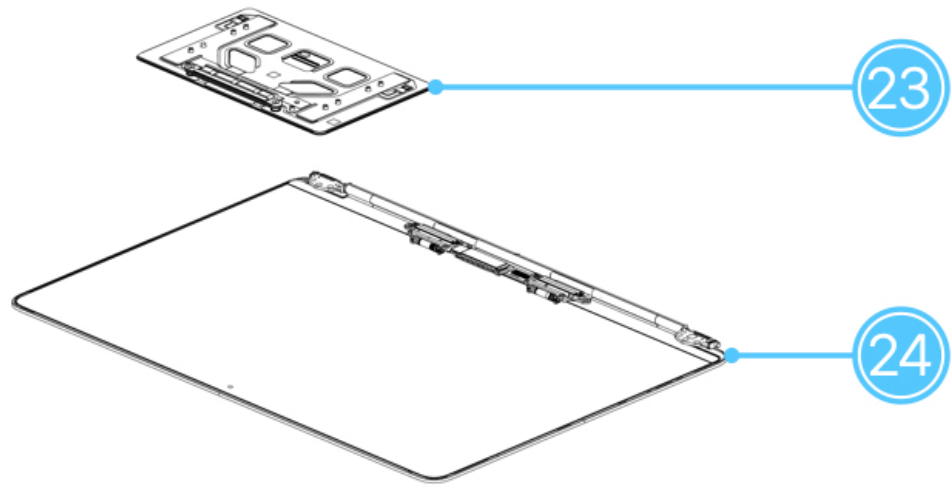
- ✓ Actuator Calibration
- ✓ Critical Error Test
- ✓ Open Test
- ! Force Check



# MacBook Pro (13-inch, M1, 2020) Exploded View

Exploded View for MacBook Pro (13-inch, M1, 2020)





#### 1. Bottom Case

- 923-04714, Space Gray
- 923-04715, Silver

#### 2. Thermal Duct

- 923-04186

#### 3. Audio Board Flex Assembly

- 923-05048, Space Gray
- 923-05049, Silver

#### 4. Cowling, Audio Board Flex Assembly

- 923-05237

#### 5. Fan

- 923-05206

#### 6. Logic Board

- 661-17057, M1, 8-core GPU, 8GB, 256GB
- 661-17058, M1, 8-core GPU, 8GB, 512GB
- 661-17059, M1, 8-core GPU, 8GB, 1TB
- 661-17060, M1, 8-core GPU, 8GB, 2TB
- 661-17061, M1, 8-core GPU, 16GB, 256GB
- 661-17062, M1, 8-core GPU, 16GB, 512GB
- 661-17063, M1, 8-core GPU, 16GB, 1TB
- 661-17064, M1, 8-core GPU, 16GB, 2TB

#### 7. Speakers, Left and Right, Pair

- 923-04169

#### 8. Clutch Cover, Right

- 923-04181

#### 9. Vent/Antenna Module

- 923-04168

#### 10. BMU Mylar Cover

- 923-04323

#### 11. Clutch Cover, Left

- 923-04182

## 12. BMU Signal Flex Cable

- 923-01448

## 13. Cowling, Trackpad Flex Cable

- 923-05233

## 14. Cowling, Touch ID board Flex Cable

- 923-05234

## 15. Cowling, eDP Flex Cable to TCON connector

- 923-05262

## 16. Touch ID Board

- 661-18346
- 923-04171, flexure (not shown)

## 17. eDP Flex Cable with Integrated Cowling

- 923-03524

## 18. Cowling, eDP Flex Cable

- 923-05235

## 19. Cowling, L-Shaped (Touch Bar touch flex cable, Touch Bar display flex cable, I/O board flex cable)

- 923-05261

## 20. Top Case Assembly with Battery (includes battery, keyboard, Touch Bar flexes, and microphone)

- 661-18432, ANSI, Space Gray
- 661-18433, ANSI, Silver

**Note:** Regional top cases have the same base part number, but they include a language code prefix (for example, Italian = T 661-18432). Be sure to choose the correct keyboard language when ordering a top case. To help determine the correct country code and keyboard language, refer to [How to identify keyboard localizations](#) (HT201794). The language code prefixes are:

- |                              |                            |
|------------------------------|----------------------------|
| • AB: Arabic                 | • KH: Korean               |
| • B: British (Great Britain) | • MG: Hungarian            |
| • BG: Bulgarian              | • N: Dutch                 |
| • C: Canadian French         | • PO: Portuguese           |
| • CH: Chinese Simplified     | • RO: Romanian             |
| • CR: Croatian               | • RS: Russian              |
| • CZ: Czech                  | • S: Swedish               |
| • D: German                  | • SF: Swiss French         |
| • DK: Danish                 | • SL: Slovak               |
| • E: Spanish                 | • SM: Swiss Multilingual   |
| • F: French                  | • T: Italian               |
| • FN: Belgian                | • TA: Taiwanese            |
| • GR: Greek                  | • TH: Thai                 |
| • H: Norwegian Bokmal        | • TQ: Turkish-Q (Turkey)   |
| • HB: Hebrew (Israeli)       | • TU: Turkish-F (Turkish)  |
| • IS: Icelandic              | • VN: Vietnam              |
| • J: Japanese                | • Z: English International |

Top case keyboards may not be available in all localizations.

## 21. I/O Board

- 923-05220

## 22. Trackpad Flex Cable

- 923-05236

### **23. Trackpad**

- 661-18429, Space Gray
- 661-18430, Silver

### **24. Display Assembly (includes TCON board and spring tensioner cables)**

- 661-17548, Space Gray
- 661-17549, Silver















### **Not Shown:**















- **Battery Cover**
  - 923-01318
- **USB-C 61W Power Adapter**
  - 661-10160
  - AR661-10160 (Argentina)
  - HN661-10160 (India)
  - MY661-10160 (Malaysia)
  - PA661-10160 (APAC)
  - TA661-10160 (Taiwan)
  - TU661-10160 (Turkey)
  - VN661-10160 (Vietnam)
  - Refer to [Find the right power adapter and cable for your Mac notebook](#) (HT201700) for additional information on identifying power adapters.



# MacBook Pro (13-inch, M1, 2020) Screw Chart

## Screw Chart for MacBook Pro (13-inch, M1, 2020)

<p>923-05241 Torx T5</p>  <p>BMU (1)</p>	<p>923-05199 Torx T3</p>  <p>eDP Flex Cable with Integrated Cowling (2)</p>	<p>923-05243 Torx T3</p>  <p>Display Clutch Covers (4)</p>
<p>923-05253 Torx T3</p>  <p>Cowling, L-Shaped (3) Cowling, Touch ID, Upper (1)</p>	<p>923-05245 Torx T5</p>  <p>TCON Board (4)</p>	<p>923-05246 Torx T3</p>  <p>Cowling, eDP Flex Cable (2)</p>
<p>923-05254 Torx T5</p>  <p>Cowling, Trackpad Flex Cable (2)</p>	<p>923-05247 3mm Hex</p>  <p>Heat Sink Arm (1)</p>	<p>923-05255 Torx T5</p>  <p>Cowling, Audio Board Flex Assembly, Upper (1)</p>
<p>923-05256 Torx T5</p>  <p>Cowling, Audio Board Flex Assembly, Lower (1)</p>	<p>923-03540 Torx T5</p>  <p>Speakers (5)</p>	<p>923-05270 Torx T5</p>  <p>Trackpad, Middle (2)</p>
<p>923-05257 Torx T5</p>  <p>Trackpad, Side (8)</p>	<p>923-05249 Torx T5</p>  <p>I/O Board (2)</p>	<p>923-05264 Torx T3</p>  <p>Touch ID, Outside (4)</p>

<p>923-05265 Torx T3</p>  <p>Touch ID, Middle (2)</p>	<p>923-05200 Pentalobe</p>  <p>Bottom Case, Upper Corners, Space Gray (2)</p>	<p>923-05201 Pentalobe</p>  <p>Bottom Case, Lower Corners, Space Gray (2)</p>
<p>923-05202 Pentalobe</p>  <p>Bottom Case, Center, Space Gray (2)</p>	<p>923-05203 Pentalobe</p>  <p>Bottom Case, Upper Corners, Silver (2)</p>	<p>923-05204 Pentalobe</p>  <p>Bottom Case, Lower Corners, Silver (2)</p>
<p>923-05205 Pentalobe</p>  <p>Bottom Case, Center, Silver (2)</p>	<p>923-05258 Torx T5</p>  <p>Fan (4)</p>	<p>923-05242 Torx T3</p>  <p>Audio Board Flex Assembly to Top Case (2)</p>
<p>923-05266 Torx T8</p>  <p>Display Clutch to Top Case (6)</p>	<p>923-05251 Torx T3</p>  <p>Spring Tensioners (4)</p>	<p>923-05259 1IPR</p>  <p>Vent/Antenna Module (12)</p>
<p>923-05263 Torx T3</p>  <p>Cowling, Touch ID, Lower (1)</p>	<p>923-05260 Torx T3</p>  <p>Cowling, eDP Connector to TCON (2)</p>	<p>923-05250 Torx T5</p>  <p>Logic Board to Top Case (3)</p>

923-05252  
Torx T5



Logic Board to Antenna Ground Clip (1)

923-05240  
Torx T5



Logic Board to Top Case, upper  
corner(1)

# MacBook Pro (13-inch, M1, 2020) Screw Location Diagrams

## Screw Location Diagrams for MacBook Pro (13-inch, M1, 2020)

### Contents:

- [Bottom Case](#)
- [Battery Management Unit \(BMU\)](#)
- [Logic Board](#)
- [Embedded DisplayPort \(eDP\) Flex Cable](#)
- [I/O Board](#)
- [Speakers](#)
- [Clutch Covers](#)
- [Vent/Antenna](#)
- [Display](#)
- [Audio Board Flex Assembly](#)
- [Touch ID Board](#)
- [Fan](#)
- [Trackpad](#)

### Bottom Case

#1



Pentalobe: 923-05203 (2), silver



#2



Pentalobe: 923-05204 (2), silver



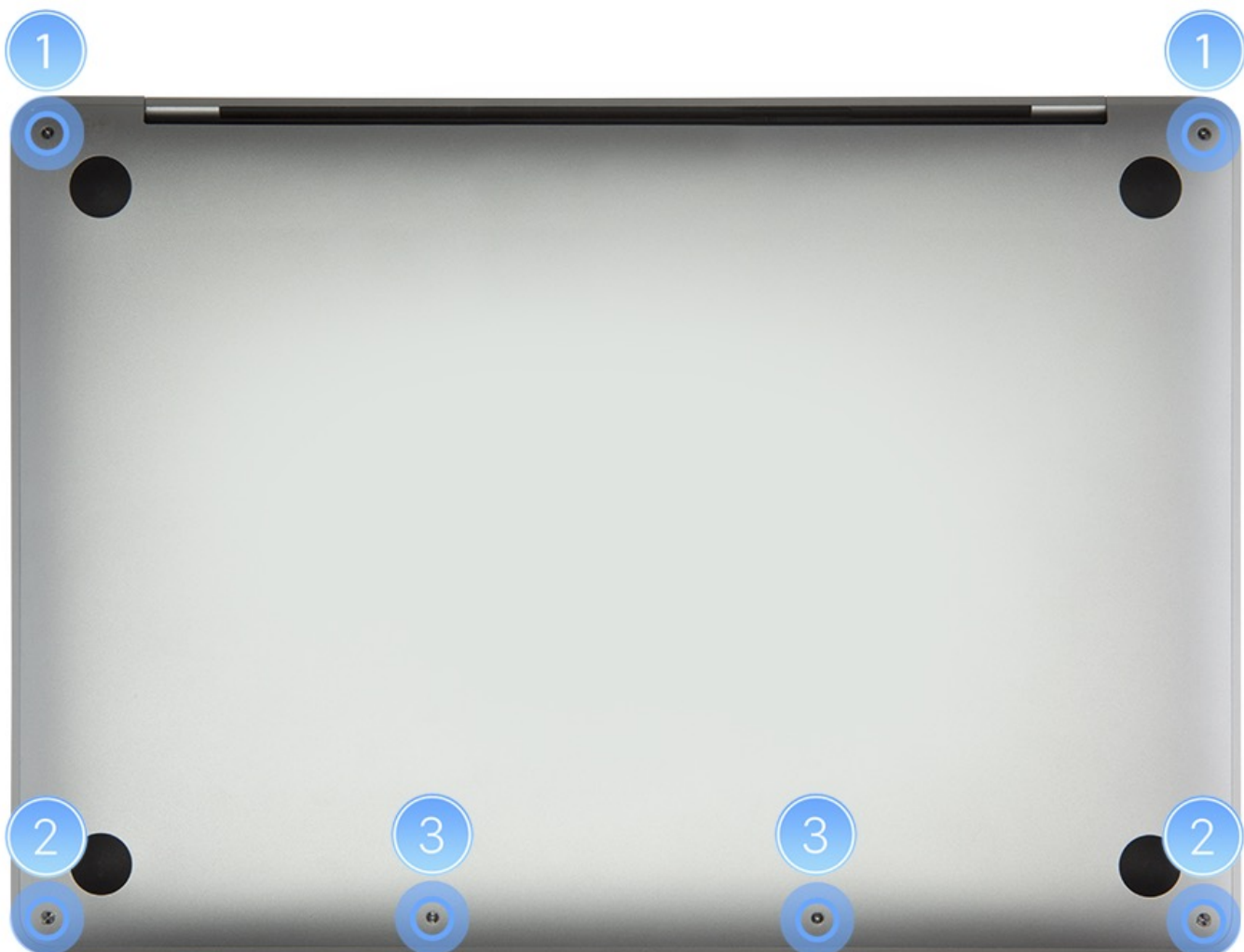
#3



Pentalobe: 923-05205 (2), silver



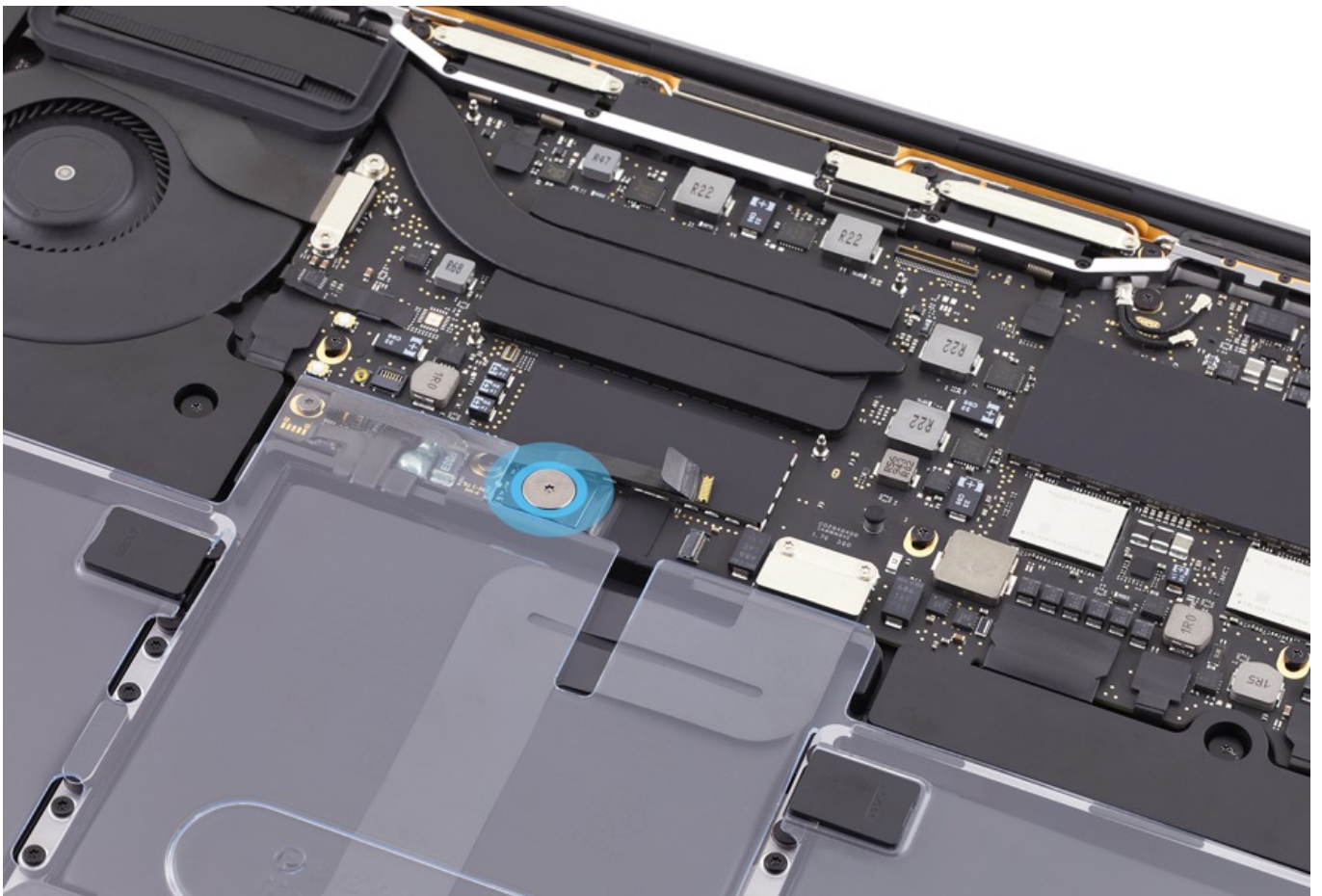




#### Battery Management Unit (BMU)

- T5: 923-05241 (1)





## Logic Board

#1

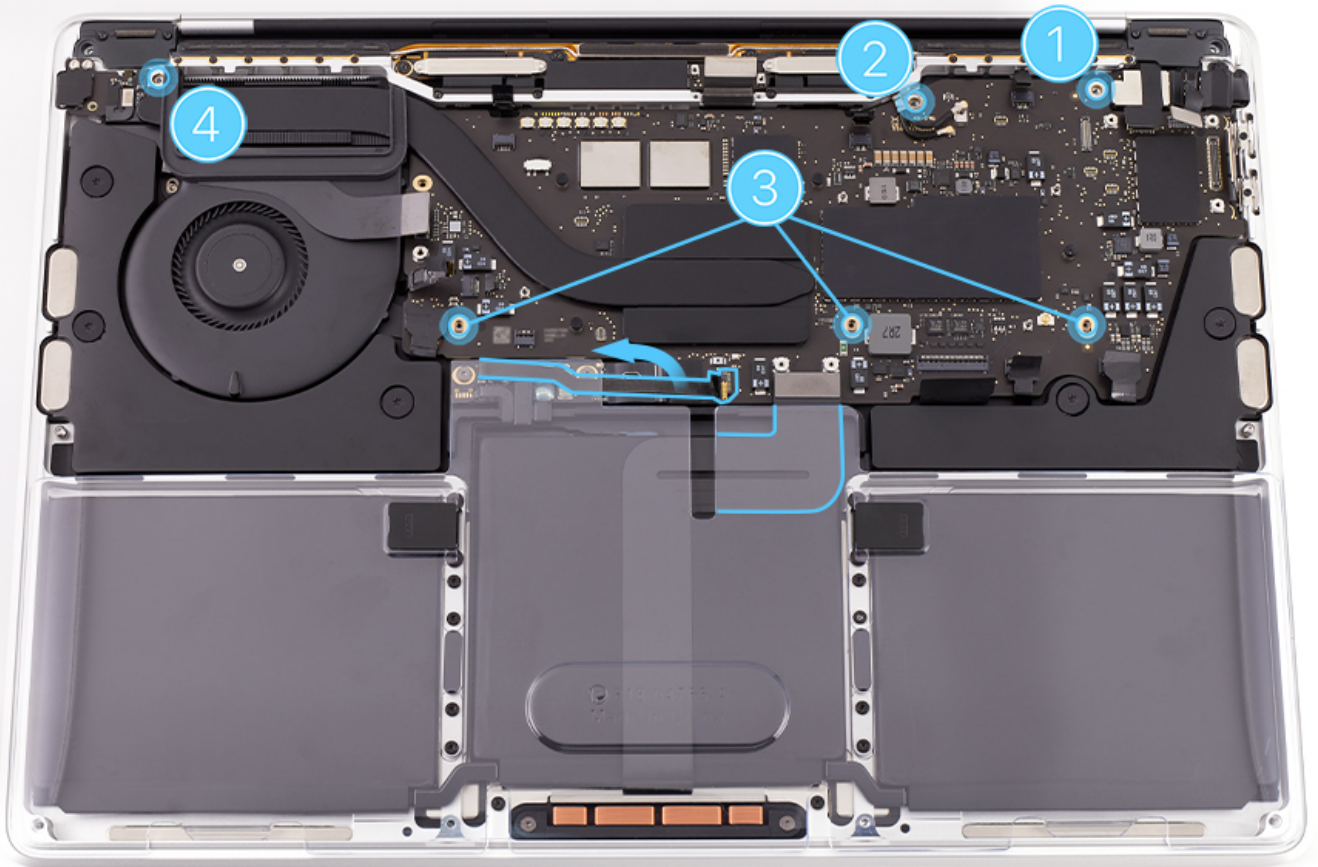
#2

#3

#4

T5: 923-05240 (1) T5: 923-05252 (1) T5: 923-05250 (3) 3mm hex: 923-05247 (1)





## Embedded DisplayPort (eDP) Flex Cable

#1

T3: 923-05260 (2), eDP flex cable cowling to timing controller (TCON) board

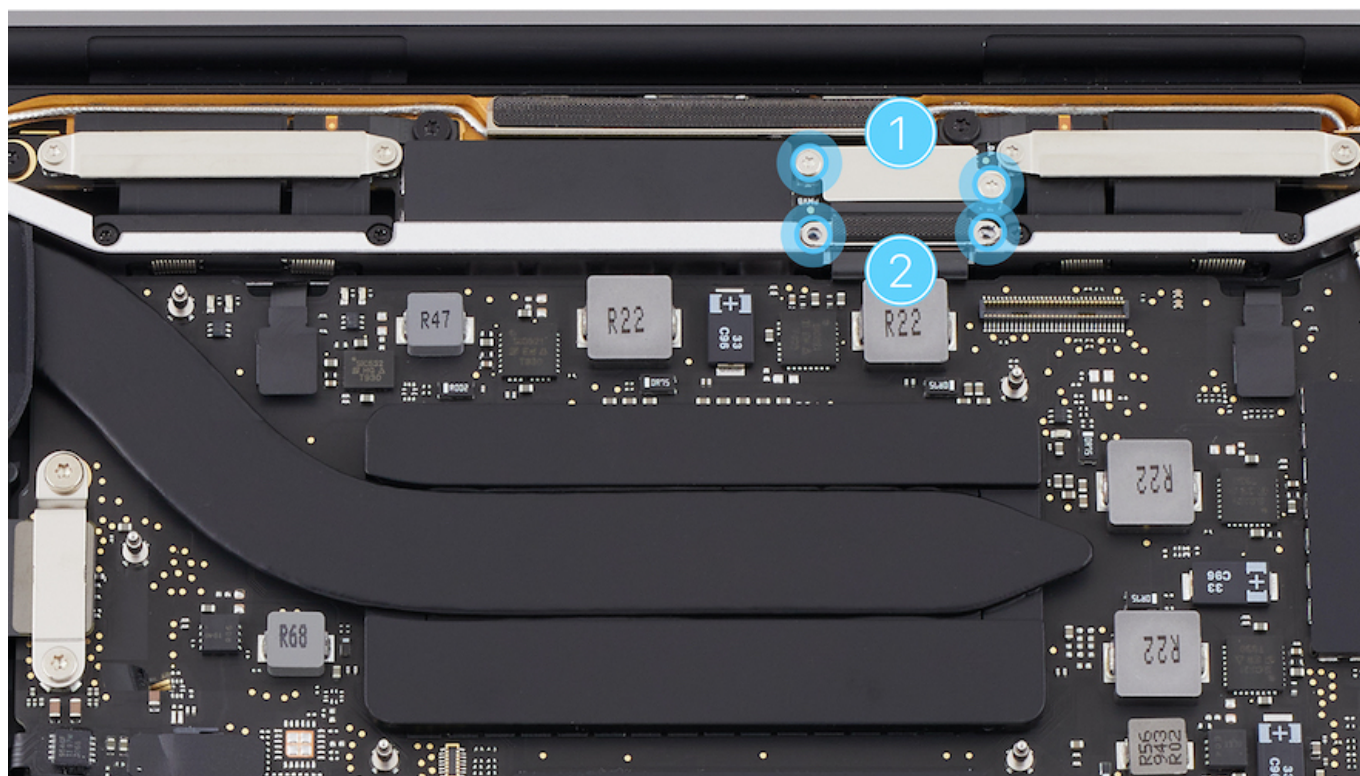


#2

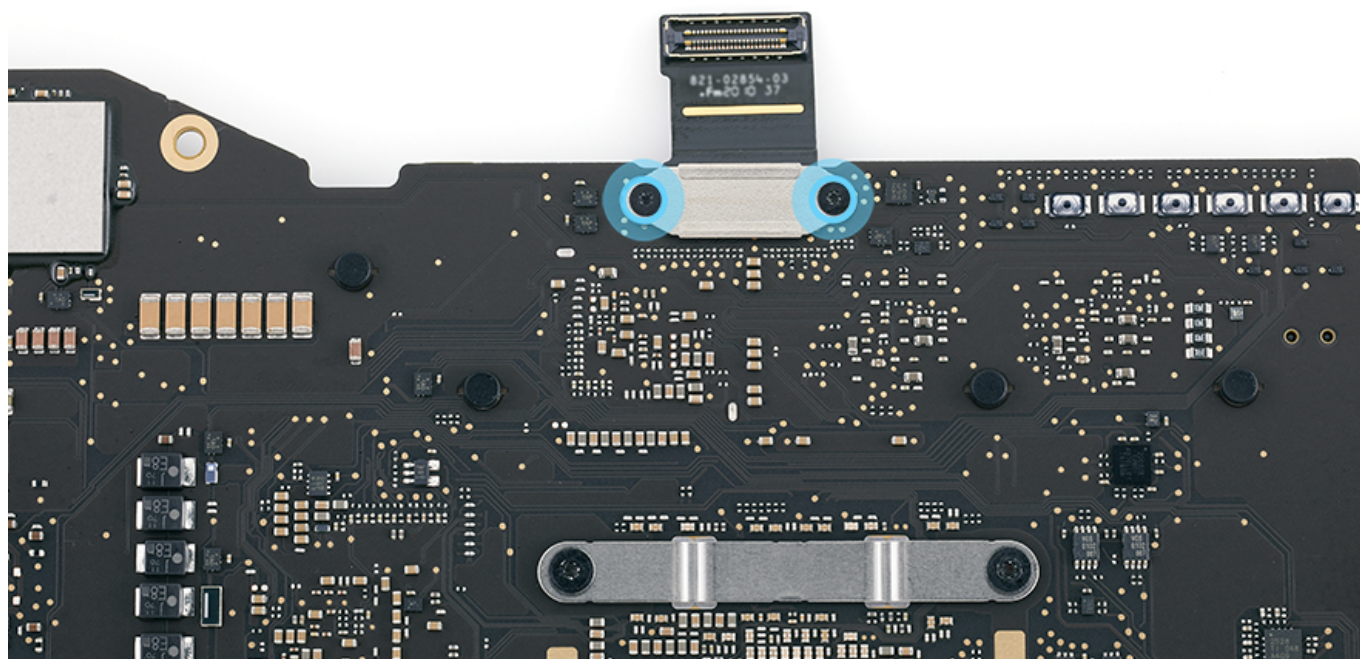
T3: 923-05246 (2), eDP flex cable cowling to top case mid-wall





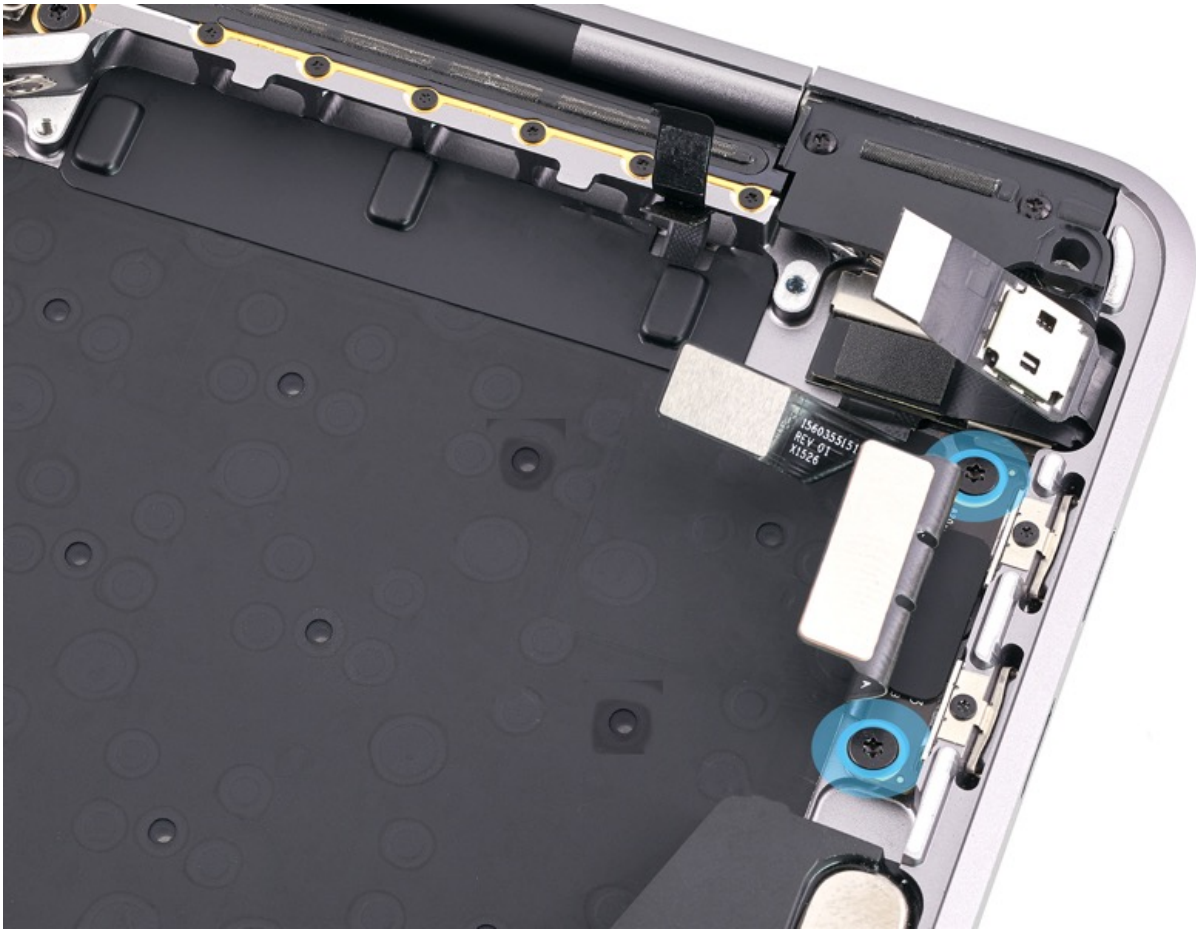


- T3: 923-05199 (2), eDP flex cable cowling to logic board





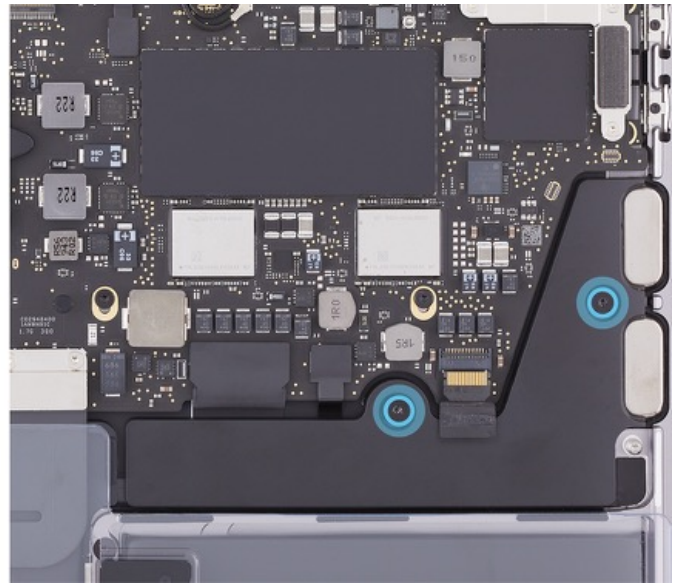
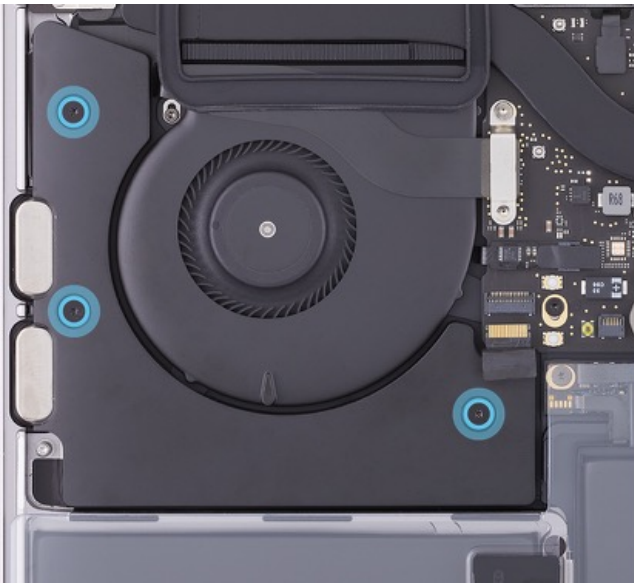
- T5: 923-05249 (2)



## Speakers

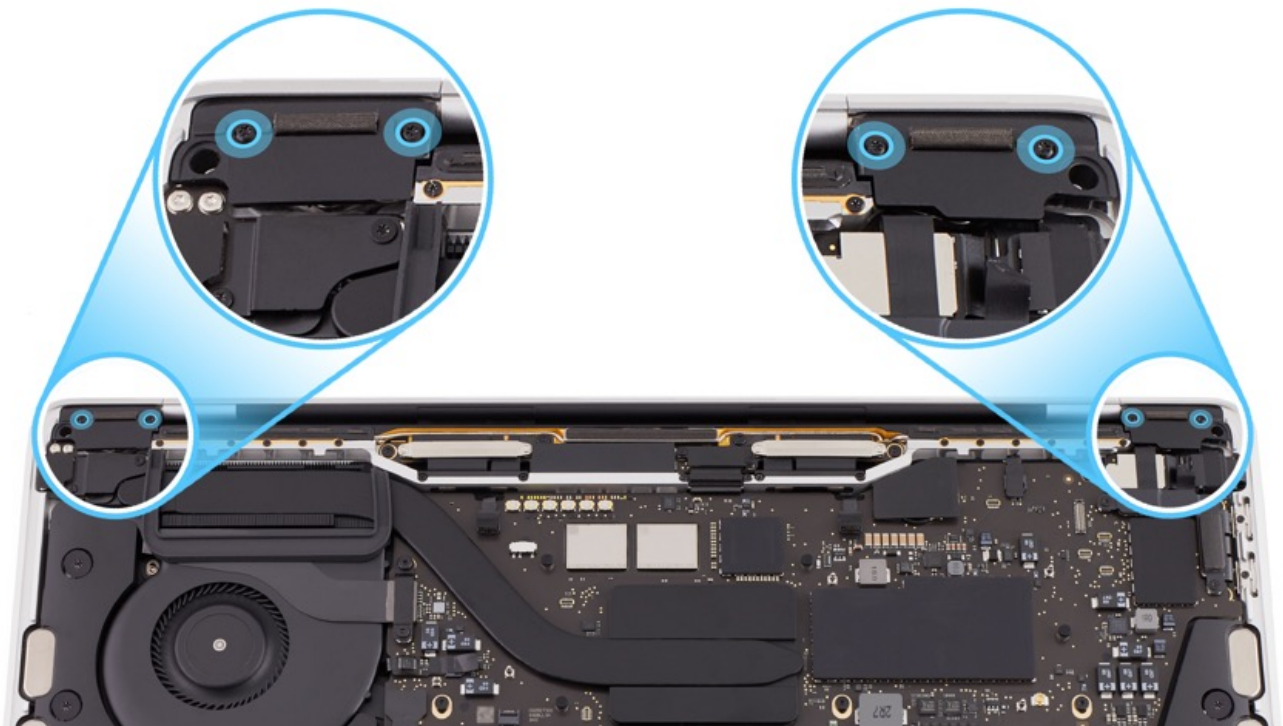
- T5: 923-03540 (2)





### Clutch Covers

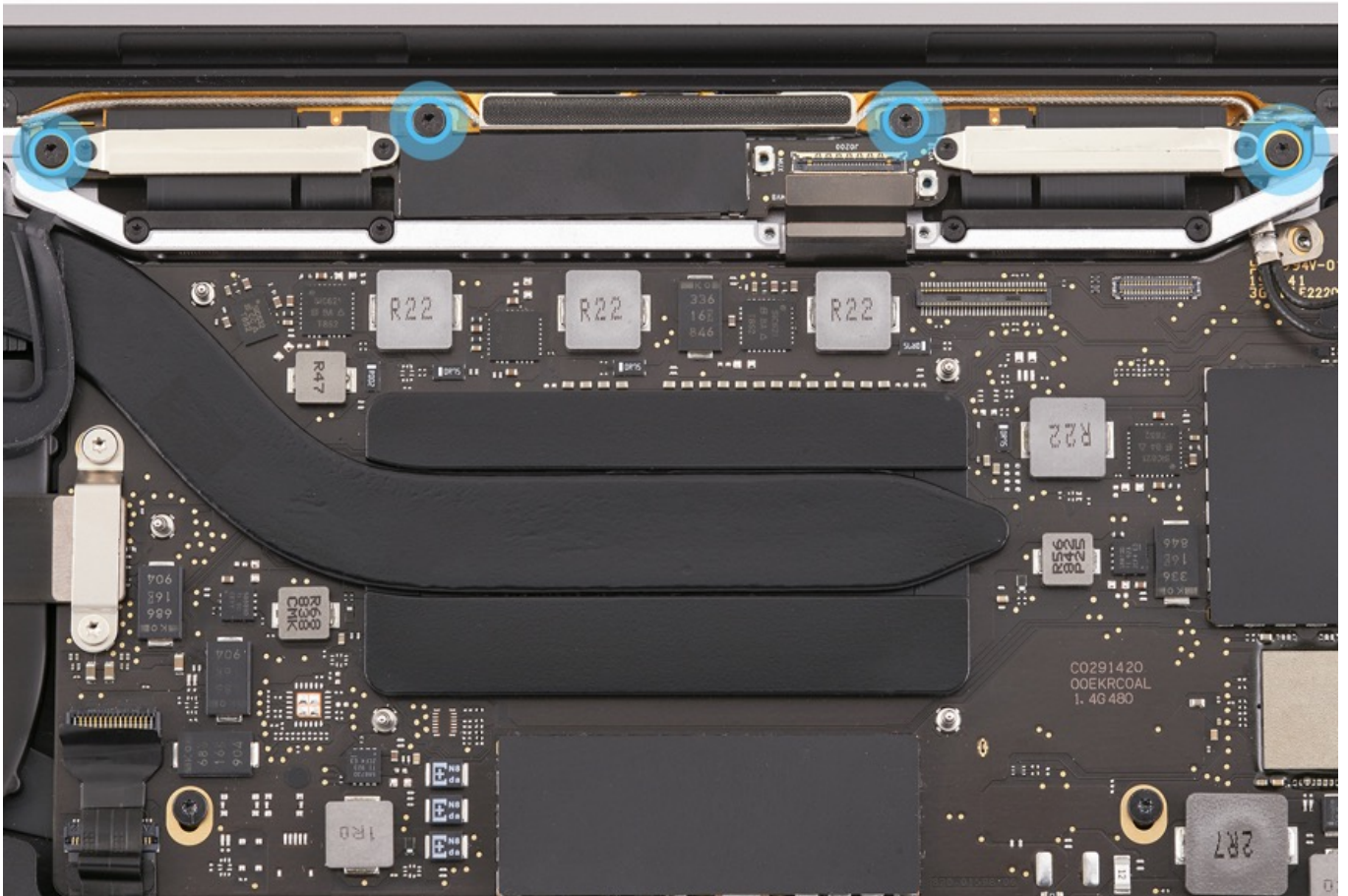
- T3: 923-05243 (4)



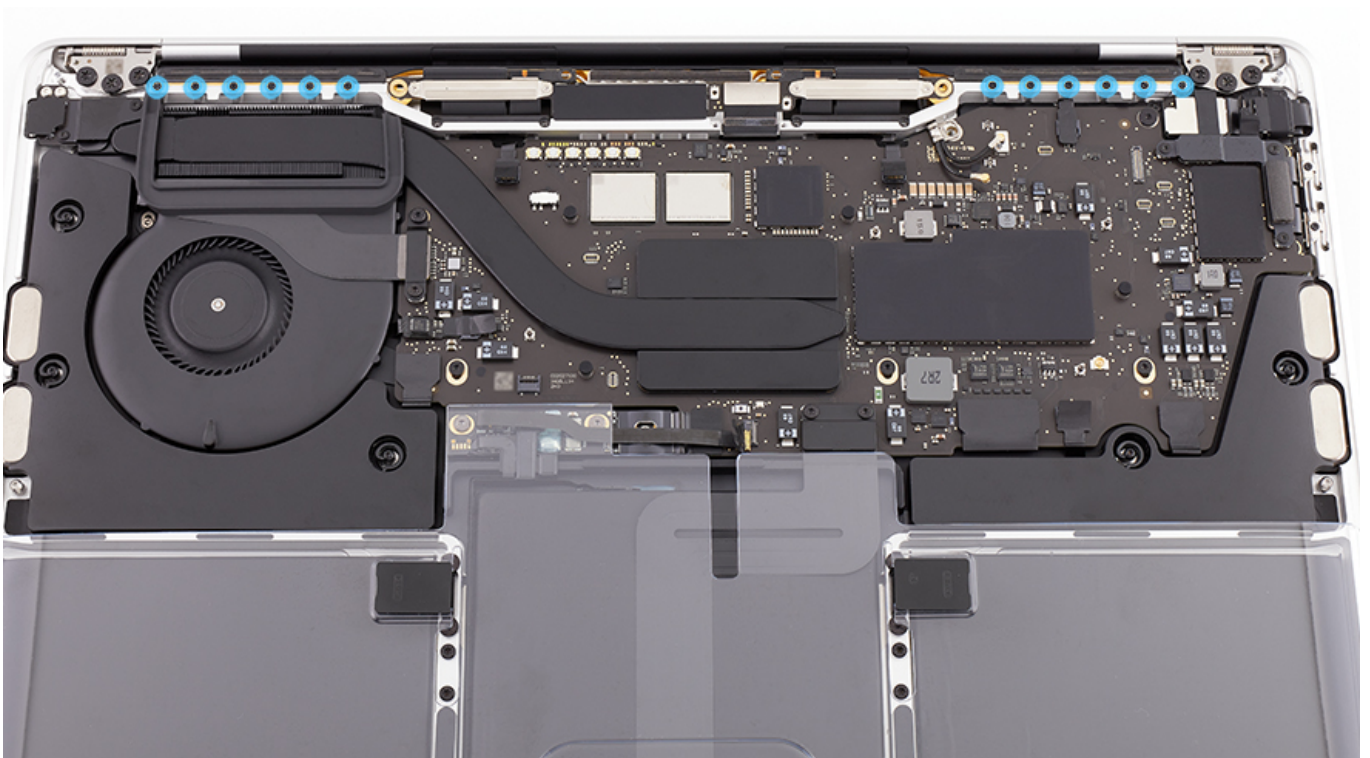
### Vent/Antenna

- T5: 923-05245 (4), TCON board to vent/antenna



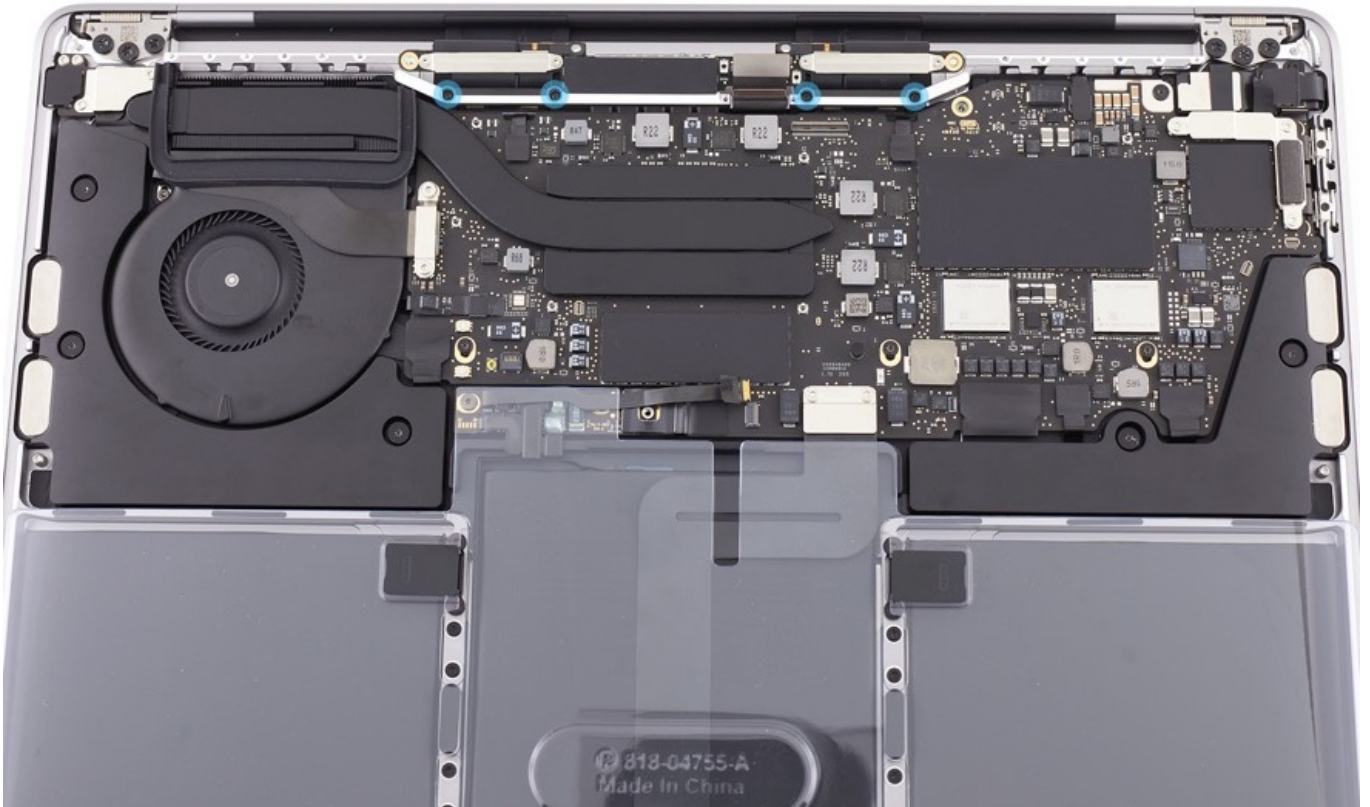


- 1IPR: 923-05259 (12)



## Display

- T3:923-05251 (4), spring tensioners



- T8: 923-05266 (6), display clutch hinges







#### Audio Board Flex Assembly

#1

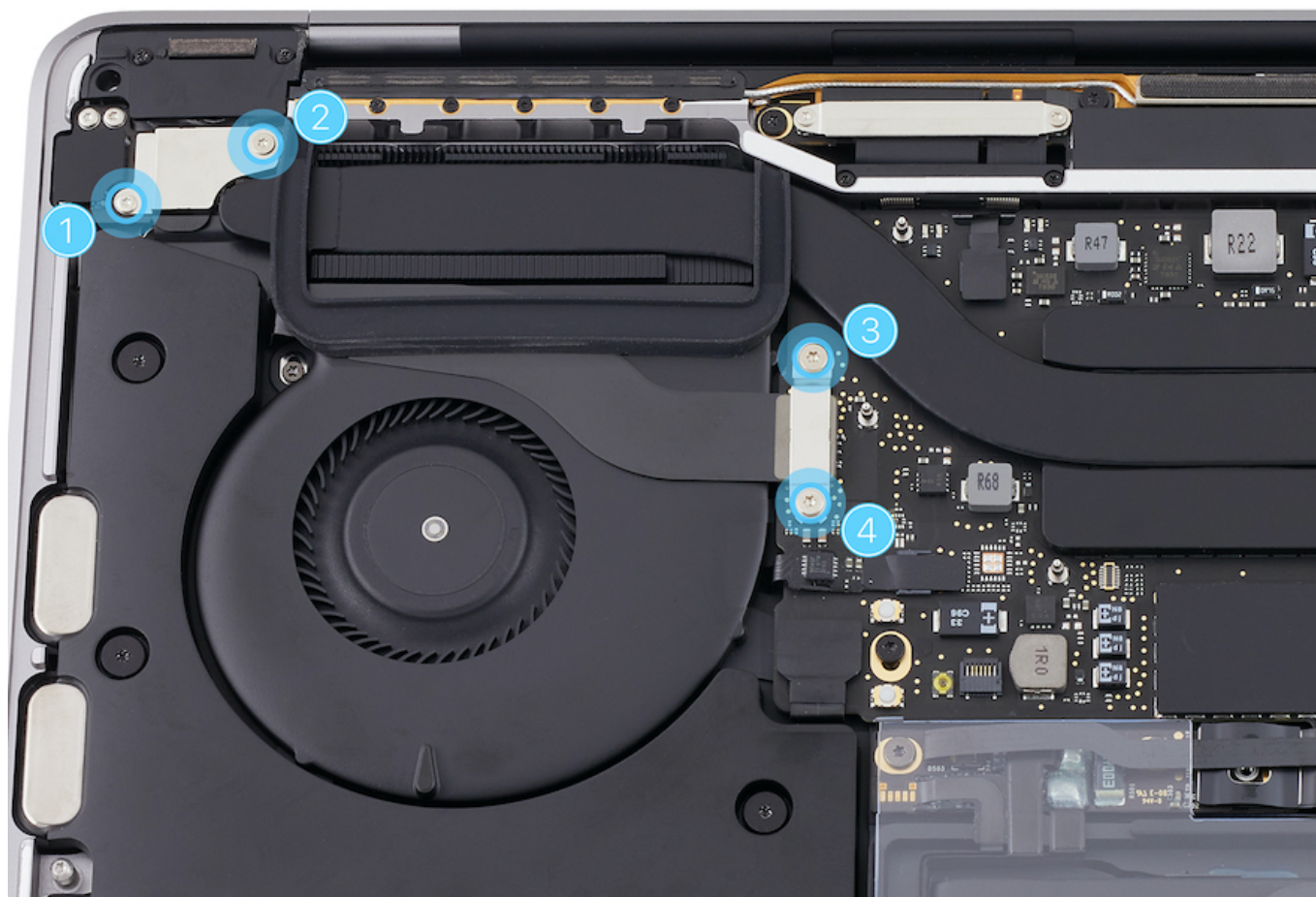
#2

#3

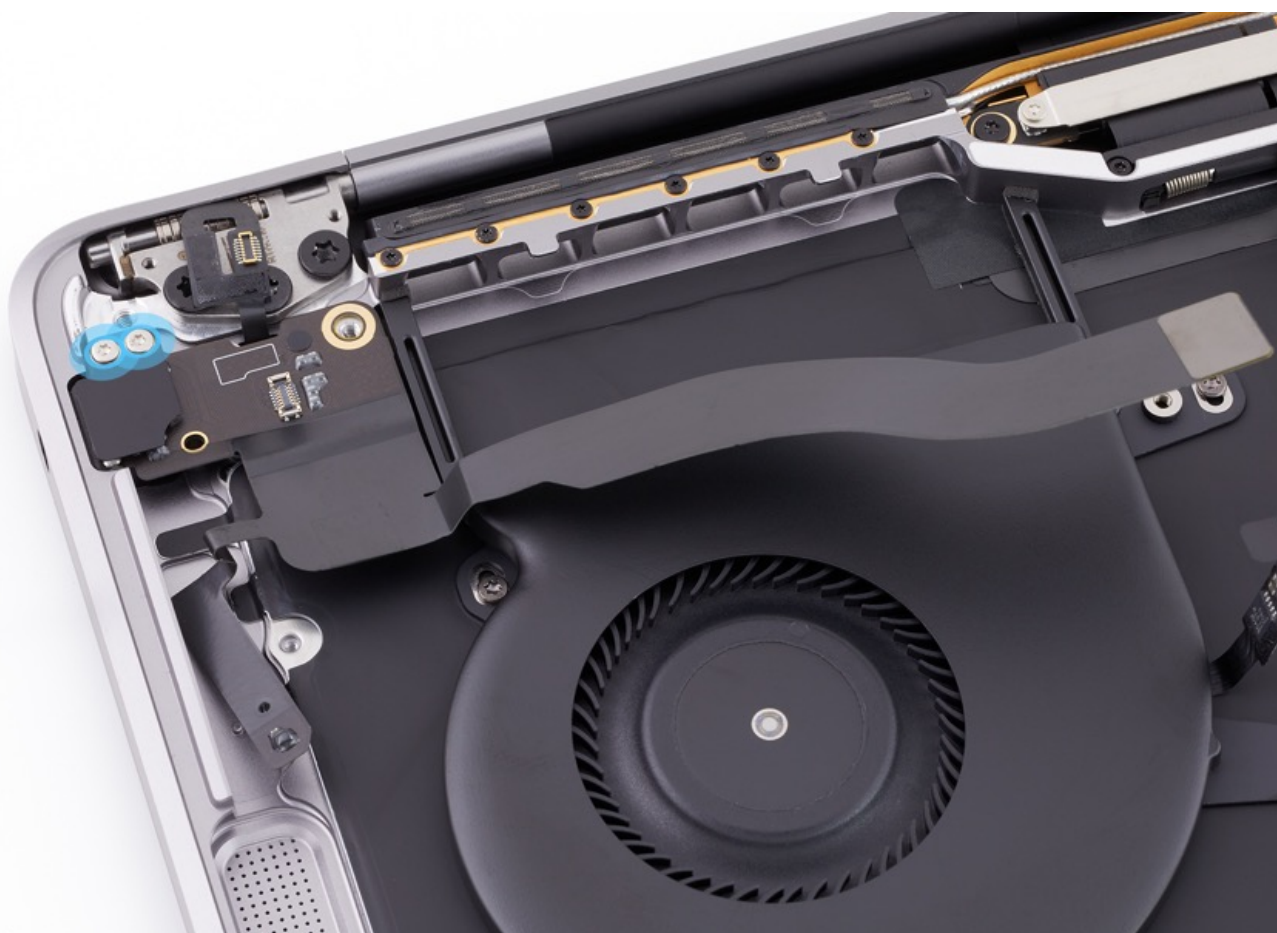
#4

T3: 923-05263 (1) T3: 923-05253 (1) T5: 923-05255 (1) T5: 923-05256 (1)





- T3: 923-05242 (1)



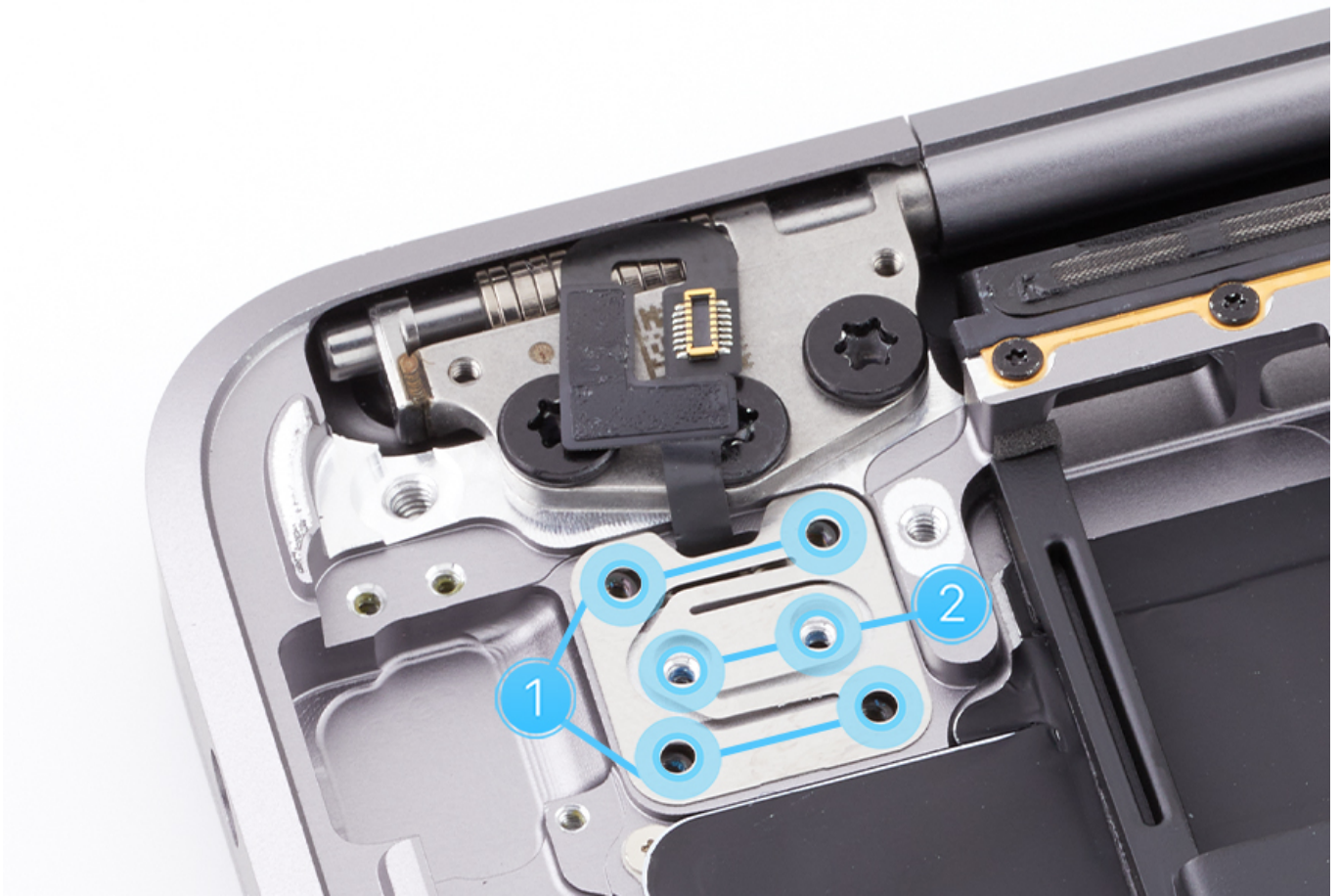


## Touch ID Board

#1

#2

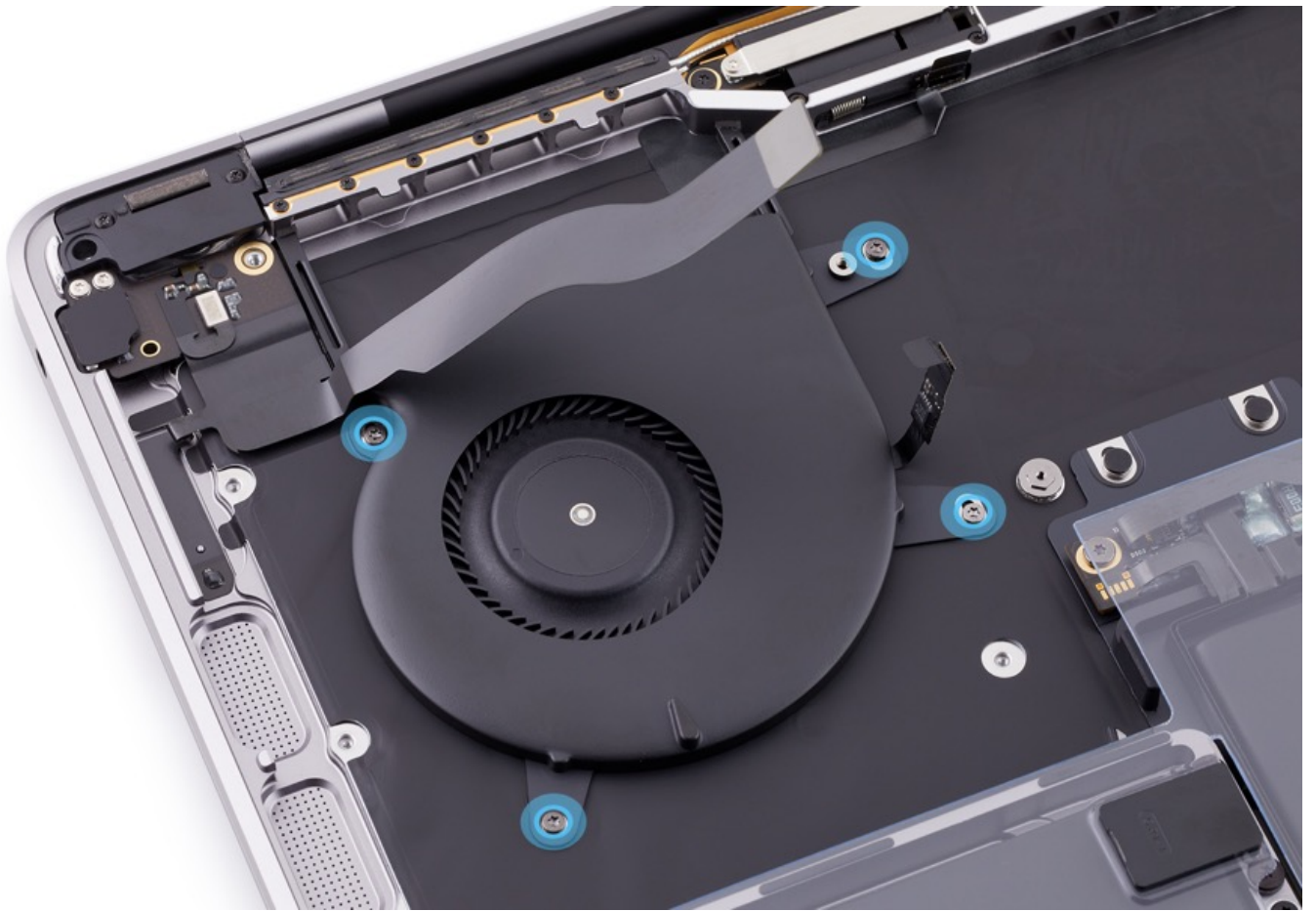
T3: 923-05264 (4), outer corners T3: 923-05265 (2), center



## Fan

- T3: 923-05258 (4)



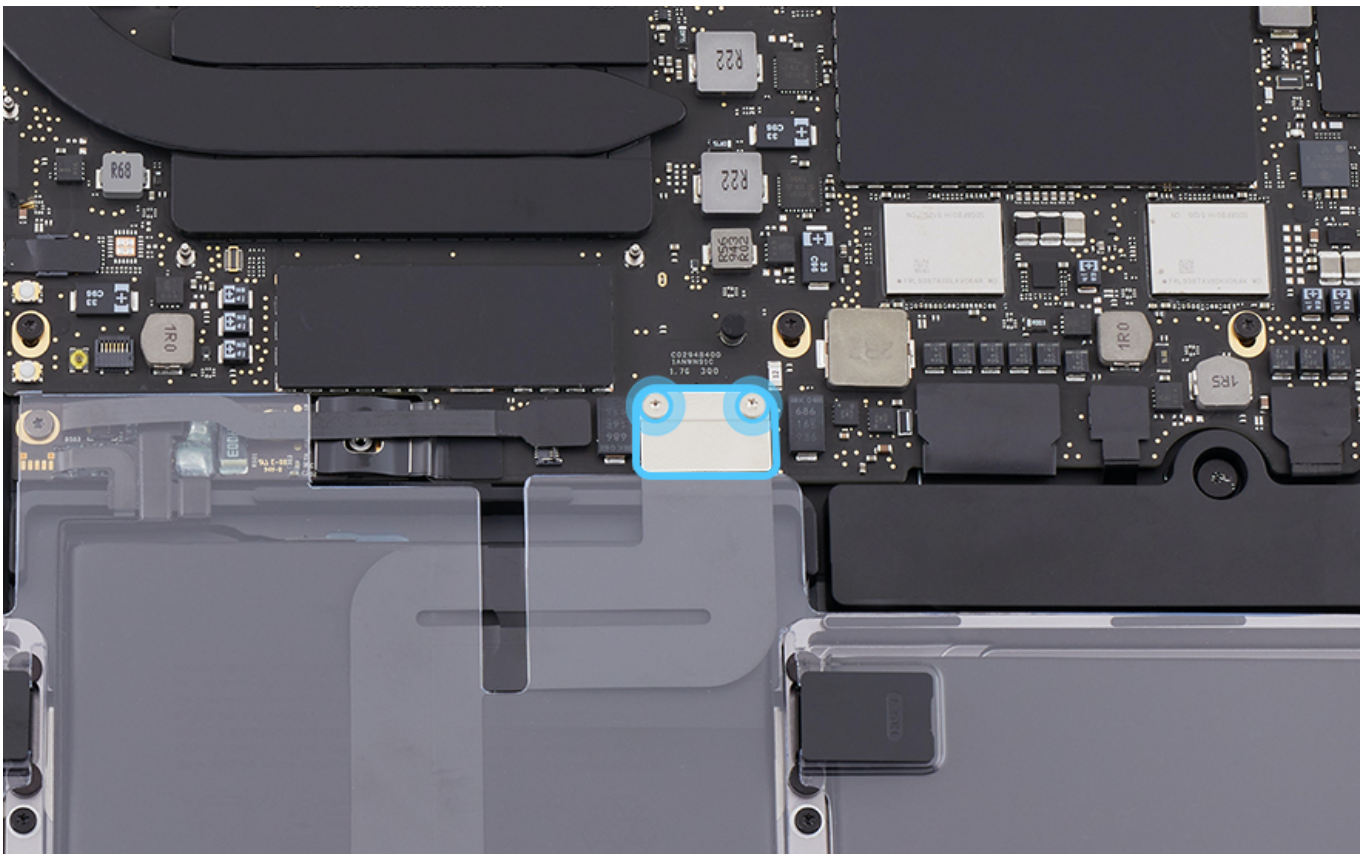


## Trackpad

- T5: 923-05254 (2)







#1

#2

T5: 923-05270 (2) T5: 923-05257 (8)

